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The Welding Engineer

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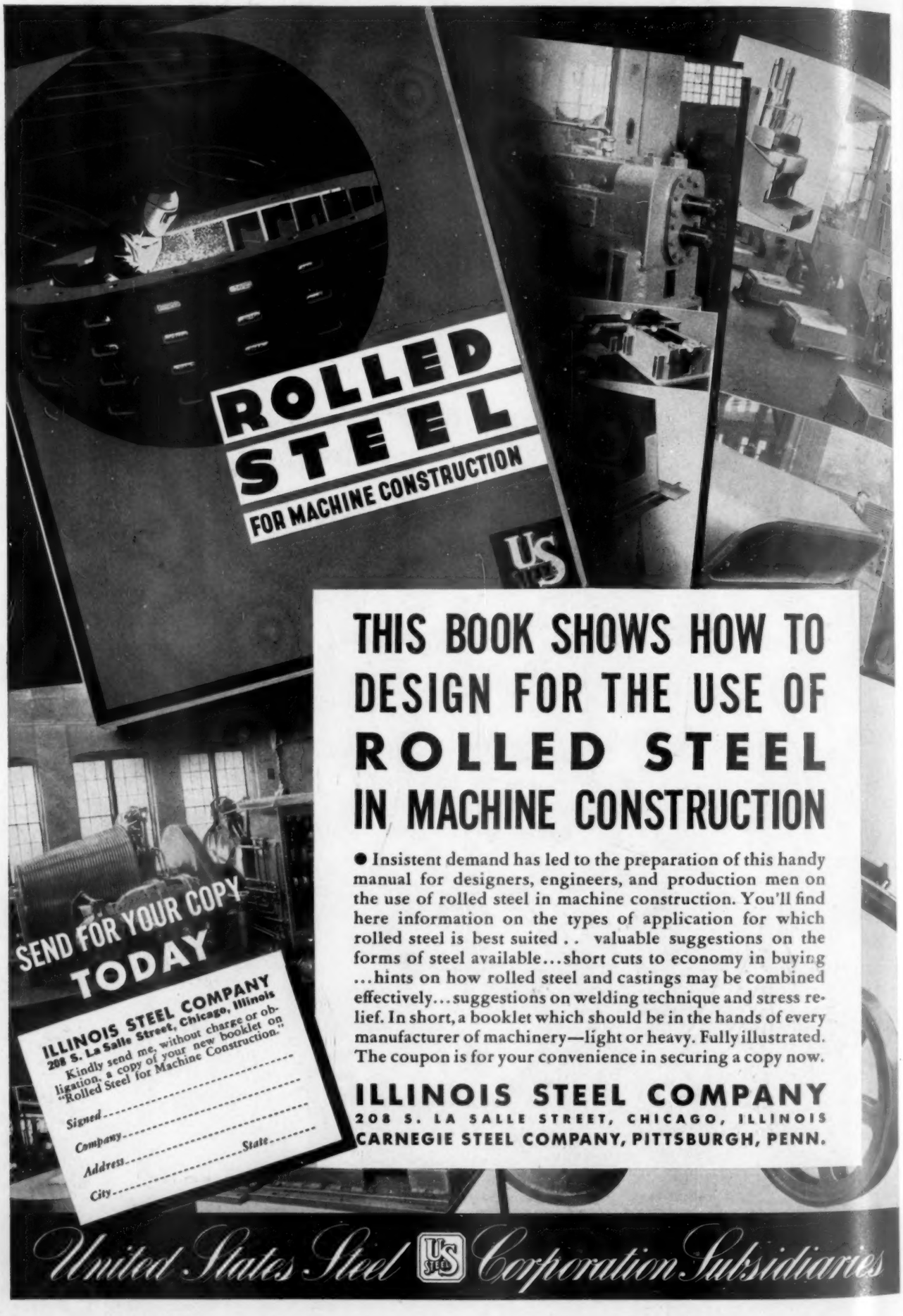

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THE WELDING ENGINEER

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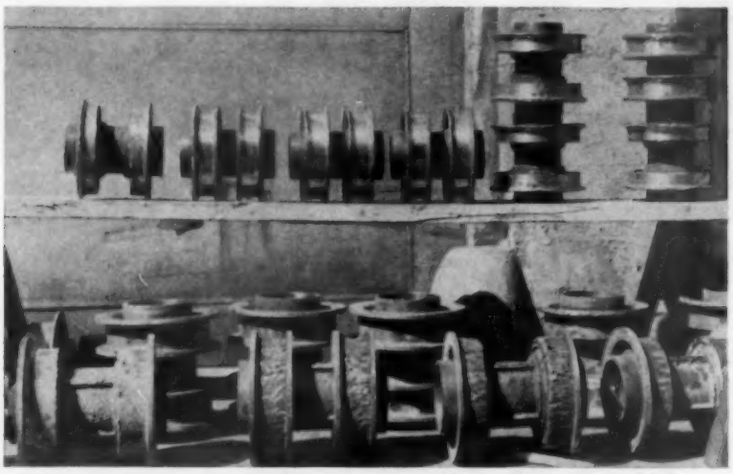

Tractor rollers after welding with Self-hardening (lower row) and after being smoothed by grinding (on table).

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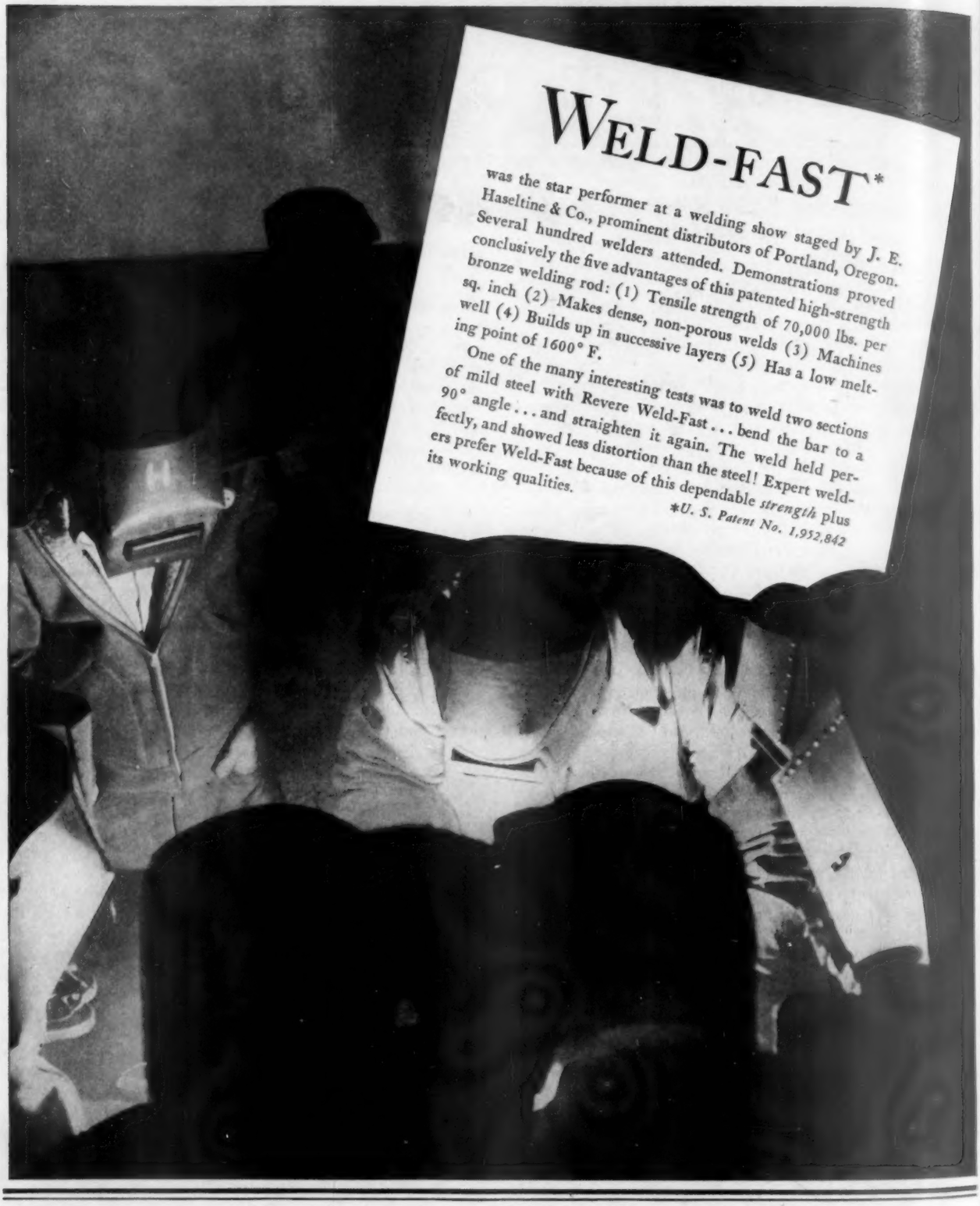
· E D I T O R I A L ·

Common Sense Is the Solution to the Accident Problem

How many fires or accidents that have been falsely laid to crossed light or power wires, will never be known, but the figure is a large one. Any form of stored up energy presents a potential hazard. In such matters many newspaper reporters and a certain section of the general public derive considerable satisfaction in posing as experts. In the early days of the electric-light-and-power industry, the impressionistic "expert," in reporting a fire, first would look to see if there were electric light or power wires leading to the building, and if there were, crossed wires was his verdict and no further investigation would be made. ¶ Such false reporting did not help the electric-light-and-power industry, but neither did it deter it from making a rapid growth. The same thing can be said of the "news" found repeatedly in newspapers or in word-of-mouth rumors, making claim that such-and-such a fire or accident was caused by an exploding acetylene cylinder, or burning oxygen gas, or exploding torches or some other equally preposterous outburst of the reporter's imagination. ¶ Even those in the welding industry will not hesitate to admit that accidents have been caused by careless handling of welding and cutting equipment, and in some cases unforeseen circumstances have created a hazardous condition that even the most careful workman probably would not have anticipated. ¶ The welding industry since its inception has recognized the inherent dangers in the use of equipment not properly protected with safety devices. Notwithstanding all the preachments of safety during the past century, humans still make errors, and hospitals are still necessary. ¶ It is doubtful that any other great industry has shown as high an interest and solicitude in safety measures as has the welding industry. Take the matter of oxygen tanks. These carry pressures in the neighborhood of 2,000 lb. per sq. in., and yet the storage and supply of oxygen under such high pressures is safe enough today that every up-to-date hospital has its supply of oxygen tanks for regular and emergency service, and if there is any place where hazardous equipment is frowned on, it should be in the hospitals. ¶ The gas in an oxygen tank has been compressed from an initial volume of 200 cu. ft. Thus it is quite evident that a bursting oxygen tank would release an enormous amount of energy, and fragments would be hurled with great force. The oxygen in the tank is subjected to all the laws of gases pertaining to expansion and contraction produced by temperature changes. Exposed to the intense heat of a hot summer sun, or to a flame, the gas would generate enormously high pressures in the tank. Actually, however, this hazard does not exist, but has been eliminated by the use of frangible discs and fusible metal at some point in the tank shell or head, and by a high factor of safety in tank construction. ¶ The cylinder and gas manufacturers have not been alone in their endeavor to promote safety, for the equipment manufacturers also have expended a great deal of effort and thought in developing and incorporating safety devices in equipment for using the welding and cutting gases. ¶ Because of the relatively high pressures of the gases in the cylinders, regulators are used to reduce and maintain the lower torch pressures at a constant value. A regulator is a comparatively simple device, consisting of a valve and valve seat actuated by a diaphragm and spring, but the parts are subjected to high pressures and frequent abuse and must have a high factor of safety. For example, the quick opening of the cylinder valve may expose the seat and other internal parts to the sudden compression of 2000-lb. oxygen pressure. This compression is attended by a severe rise in temperature which may be sufficient to cause ignition of the seat material with the possible hazard of injury to the operator unless protection is provided. Manufacturers of regulators, realizing this hazard, have for the most part provided design features which eliminate the possibility of this condition. ¶ In the event of serious damage to the regulator seat, the diaphragm may be called upon to sustain the full cylinder pressure. The diaphragm is a relataively light, flexible sheet-metal or rubber-composition disc which is neither designed nor calculated for the stress that may apply due to failure of the seat to hold the pressure tight. In the case of a 2½-in.-diameter diaphragm, which has an area of about 5 sq. in., the exerted pressure will amount to 10,000 lb. The bursting of a diaphragm under this pressure will generally carry away the regulator bonnet with terrific force; this was not an unusual occurrence and hazard in the earlier days of the industry. Improvements in construction, larger factors of safety, and adequate methods of relieving and venting excessive pressures have rendered such accidents almost unknown during present times. ¶ The interchanging of oxygen and acetylene regulators would be an occasional occurrence were it not that features of design prevent this. The careless workman cannot secure a left-hand-thread regulator onto a right-hand-thread valve. The use of right- and left-hand threads is one of the means taken to prevent the attaching of an acetylene regulator to a high-pressure oxygen tank and the consequent bursting of the regulator diaphragm and gauges. It is also apparent that the interchanging of oxygen and acetylene hose at the torch or at the tanks would present a serious hazard to the welding or cutting operator. Some years ago the Gas Products Association started a movement for the use of right-hand thread for oxygen hose and left-hand thread for the fuel-gas hose. This practice is now universal in this country and is required by the Underwriters' Laboratories and accepted as standard by the U. S. Army and Navy. ¶ In the matter of other welding and cutting equipment, very much the same story could be told as for gas tanks and regulators. The development of the acetylene generator is a story of continual changes in design and materials to eliminate hazards in the production and use of aceytlene gas. ¶ Despite all the precautions taken by manufacturers of welding and cutting equipment and gases, in the safe design of tanks and equipment, and notwithstanding all the regulations and rules that have been issued, outlining the proper use of such equipment, fires and accidents attributable to the disregard of these rules have been on an increase during the past few years according to the report of the Associated Factory Mutual Fire Insurance Companies. Virtually all such hazards would be eliminated by the use of ordinary common sense on the part of the operators. The operator who uses a cutting torch near inflammable material is courting danger. Many fires have been started from such carelessness. Oxygen and acetylene tanks that are in use should not be placed in inaccessible positions, but should be so located that someone can quickly get to them and shut off the flow of gas if necessary; a disregard of this rule recently resulted in a serious accident costing two men their lives. These precautions, and many others, are dictated in the name of good sense. ¶ The manufacturer has shown a high regard for human life and property by developing safe apparatus and equipment for use in welding and cutting, even at the expense of substituting costly designs and materials for old. The next move is up to the operator, who by the exercise of good sense can cut down very materially the fires and accidents resulting from the use of cylinder gases and equipment.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*U. S. Patent No. 1,952,842

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The Welding Engineer

VOLUME 20 JULY, 1935 NUMBER 7

Distortion-Control Procedure

■ By DAVID BOYD and GORDON CAPE
Dominion Bridge Company, Limited

PROCEDURE for control of distortion in heavy weldings must be based on a knowledge of the behaviour of steel under the stresses introduced by the welding process.

It is known that a cube of steel when heated expands uniformly in all directions, and, conversely, when cooling contracts uniformly unless restrained by mechanical forces from doing so. Briefly, then, we are faced with this problem when welding any mild-steel structure, but the condition is aggravated as the weight and stiffness of the structure increase.

The factors governing stress-strain conditions in a welded frame are: Welding technique; procedure or sequence of welding; accuracy of fit-up and design of the structure. These factors will be treated individually in an attempt to construct a composite picture of just what happens when a stiff structure is welded.

Should One Use Small or Large Electrodes?

Two schools of thought exist with regard to welding technique: the first insists on using small electrodes with comparatively low welding currents, while the second advocates the use of large electrodes and high welding currents.

The "small-electrode, low-heat" school claim that welds placed with this technique produce less distortion and lower residual stresses. Their opponents, of course, claim similar advantages for their own technique, plus lower costs. The argument has been waged between them for years, neither being prepared to concede the other correct.

A long series of tests has been carried out by students in the Graduate School at McGill University with the cooperation of the Dominion Bridge Co., Ltd., with a view to evaluating the stresses set up in plates due to welding.

A DISTINCTION is made between plate stresses and weld stresses, and the authors discuss the limiting of these stresses by the application of heat, by proper joint preparation, and by welding sequence. They propose that large, complicated members be assembled from smaller welded units, by a semi-flexible method of assembly, allowing all work to be done downhand and eliminating costly step-back welding. This paper was given before the Symposium on the Welding of Iron and Steel, in London, England, May 2 and 3, 1935.

The test plates were designed purely from an experimental viewpoint, and no attempt was made to simulate actual joint conditions (Fig. 1). The test plates were prepared as indicated, and welds were made with both bare and covered electrodes. Welding technique was varied in the case of both electrodes. Half the plates were welded in one pass, while the other half were welded in two passes. The total volume of weld deposited was the same in all cases. Plates were carefully measured both before and after welding by means of a linear comparator between fine gauge lines scribed on the surface. Plates were then cut longitudinally into strips. The first strip was practically entirely composed of weld metal. On slitting the strips from the plate a portion of the strain in the strip proper would be released—that portion which was produced by elastic deformation. That portion of the strain produced by stress beyond the elastic limit is not, of course, released. These recoveries were measured and used to calculate the average values of elastic stress.

The experimental work is completely reported in theses submitted for the Master of Science Degree at McGill University and summarized in a paper presented at the Fall Meeting of the American Welding Society. The paper was published in the *Journal of the American Welding Society* for December, 1934.

For the purposes of this paper it suffices to say that the findings were as follows:

The investigation as outlined was designed to obtain data on the stress distribution throughout the welded plates. In addition, the method used also allows

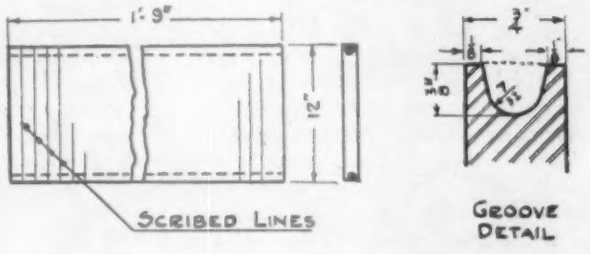


Fig. 1. Details of Test Plate.

(The edge grooves were filled with weld metal, deposited with both bare and covered electrodes, after which stresses were evaluated by cutting longitudinal strips from the plate and measuring the changes in deformation.)

of differentiation between the stress in the weld and the stress in the plate. This fact is important in that there has been much loose thinking in this connection, many persons failing to realize that there can be a wide difference between the stresses in these two regions and that the difference is controllable by technique.

The following table gives average values of stress observed in the weld proper:

Weld	Stress in Weld
Bare Electrode One Pass	12,000 lb. per sq. in.
Bare Electrode Two Passes	19,000 " "
Covered Electrode One Pass	27,000 " "
Covered Electrode Two Passes	37,000 " "

the weld groove in all cases being as in the sketch in Fig. 1.

The detailed results of the tests can be found in the article already referred to and it is not proposed to include them in this paper. The stress conditions existing *in the plate* adjacent to the weld may be summarized as follows:

(1) That multi-pass welds produced a *lower* stress *in the plate* than did single-pass welds of the same total size.

(2) That welds made with covered electrodes gave rise to *higher* stresses in the plates than those made with bare electrodes.

(3) That in the case of welds made in two passes with covered electrodes and not peened or stress-relieved by heat treatment, the stress *in the weld* was in the neighborhood of 30,000 lb. per sq. in.

Note that in item (1) above the words *in the plate* are italicized. It is necessary to realize that the weld stress and plate stress are essentially different quantities.

High Weld Stresses Ge Hend-in-Hand With Low Plate Stresses

It is possible to achieve low stress in the plate material, but the penalty is the acceptance of excessively high weld stresses.

This statement can be more readily appreciated by considering what factors cause the stresses that exist in and around a welded joint. The stress in the weld proper is due primarily to the shrinkage of the weld metal on cooling from the plastic state at about 1800° F. to the cold state.

This stress in the weld also gives rise to stress in the plate material, but the magnitude of this plate stress is a function of the relation between the size and rigidity of the plate and the weld size. For example, a small weld joining relatively heavy stiffly held plates will itself be very highly stressed, but the average plate stress will be of no consequence.

The stress in the plate is one which combines the stress induced in the plate due to weld shrinkage and the stress set up in the plate due to the heat of the welding process. Under certain conditions the stress produced in the plate due to local heating and upsetting may exceed that produced by weld shrinkage.

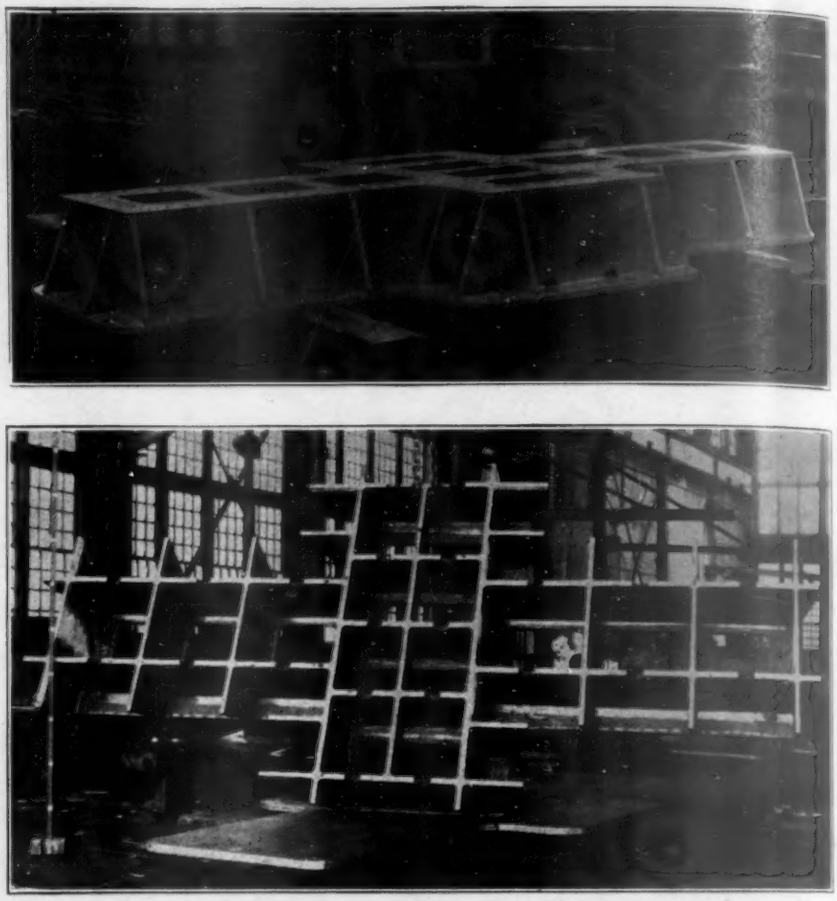


Fig. 2. Views of Pier Member, or Shoe, the Top View Being the Completed Member, and the Lower View Showing the Grid Construction.

Small Electrodes, With Low Heat, Result in Low Plate Stresses

This gives a basis for a direct comparison of the two welding techniques. Obviously the "small-electrode, low-current" technique minimizes the heating of the plate material and reduces the residual plate stress due to heat to a minimum. Conversely, however, the weld shrinkage stress is forcibly confined to the weld proper, since the plate material near the zone of fusion is kept cold, and is therefore not plastic. This results, as has been seen, in low plate stress but high weld stress. The "large-electrode, high-current" technique tends to balance the two stresses. It certainly causes higher plate stresses, but gives a definite reduction in weld stress. Either technique will produce sound results if properly carried out; similarly, either one if carried to extremes may produce undesirable stress conditions.

The large-electrode, high-current technique appears for the above reasons to be more desirable than that using small electrodes and low currents. There is no doubt that the large-electrode technique puts more stress in the plate, but the stress in the weld is definitely lower—about 25%. When one considers that the weld, as deposited and before heat-treatment, has a tendency to brittleness, especially on heavy work, obviously the technique that gives lower stresses in the weld material is the more desirable.

It is well to note that the test plates as designed indicate nothing but longitudinal weld and plate stresses. The stresses as measured, therefore, are consistently lower than those encountered in practical welded joints. The stresses in actual joints are the resultant of combined longitudinal and transverse stresses and are therefore higher than those indicated by the tests.

Procedure control can limit residual stresses but cannot eliminate them. It is folly to expect any technique or procedure to produce a stiff structure free from pre-loading due to contraction stresses in the welds.

Stresses of 30,000 Lb. Reduced to About 3,000 Lb. by Heating

Stress-relief by heat-treatment reduced the stresses to approximately 10% of those existing in the plates as welded. This applies directly only to the plates which had a stress after welding of over 30,000 lb. per sq. in. The residual stress after stress-relief lay between 3,000 and 5,000 lb. per sq. in. in all cases. This establishes stress-relief by heat-treatment as a necessary accessory to welded

construction when stiff structures are involved.

Metallurgical studies, on fiber stress in billets resulting from heat-treatment and quenching at different temperatures, give results that are helpful in devising weld technique. These investigations show that as the temperature of the quenching medium rises, the fiber stress in the quenched steel falls. This reduction of stress is effected by comparatively small temperature changes. One test showed that with a quenching temperature of 70° F. the residual fiber stress was 42,300 lb. per sq. in. Raising the quenching temperature to 212° F. reduced the resulting stress to 17,650 lb. per sq. in., and an increase to 300° F. reduced the fiber stresses to 12,890 lb. per sq. in.

Welding, while not strictly analogous, is similar. A molten material is deposited, and cools so rapidly in place that the phenomenon is truly that associated with quenching. The quenching medium, when welding is involved, is the heavy material of the structure.

It appears from the foregoing that if the material were to be preheated before welding, and maintained in the preheated condition during welding, the stresses in the welds would be minimized.

Cracked Welds Eliminated by Preheating to 200°F.

This has been clearly borne out in practice. Several very rigid structures were welded, employing preheating to about 200° F., without any difficulty whatever. During the progress of the welding of some of these structures, it was thought expedient from a production viewpoint to eliminate the reheating operation when the material had cooled owing to radiation. As the temperature of the member dropped below 150° F. trouble was immediately encountered from cracked welds. Reheating immediately removed the difficulty, pointing in a very conclusive manner to the necessity of preheating heavy rigid structures while welding.

Experience along the lines outlined above has shown that the optimum condition for heavy welding is to employ as high a preheating temperature as the welders can withstand. It is the authors' opinion that a temperature of about 200° F. is satisfactory.

Preheating is achieved by placing the members upon coils heated by steam. It would, of course, be desirable to have steam-heated ovens, if possible, but the steam coils placed on the shop floor have so far answered the problem satisfactorily.

It is impossible to overemphasize the importance of accurate fit-up of parts. All preparatory fabrication operations on plates and sections should be carried out with as high a degree of accuracy as is commercially obtainable on work of this character. While this accuracy of fit-up applies principally to members built of heavy material, it also applies in a degree to light work.

Recognition of the necessity for mechanically tight joints is the consideration that justifies the expenditure of considerable time and money in planing plate edges, as was done on the pier members which will be described. This planing is done not only when plates are scarfed for butt welds, but also when fillet welds are specified.

Welding Tight Fits Without Danger of Preloading

Joint preparation has a very important bearing on procedure for the control of distortion. With all joints in a structure tight before welding is started, there can be no local distortion of the individual parts, but all distortion will be mass distortion of the complete member. Local distortion is of assistance in relieving stress, but for reasons of appearance and for the maintaining of accuracy of alignment it cannot be permitted. It is true that the weld stresses will be higher with tight fitting than if joints were not perfect, but procedure and preheating will keep these well below the ultimate value of the weld metal. Stress-relief by heat-treatment when welding is completed, *or even during progress of the work if necessary,* reduces the residual stresses to a value that precludes any possibility of preloading.

It will be said that distortion is a function of the stresses set up in the main material of the structure. The purpose of this paper is to show that, while the technique adopted tends to give rise to severe distortion, the procedure employed is so devised as to limit and control the condition.

There are two generally used methods of proceeding in fabricating parts by welding:

The first method, and one that is useful on light work, is to tack-weld the parts together and proceed with welding with the work clamped rigidly. This method requires careful planning of welding sequence to minimize distortion, but inherently gives rise to severe locked-up or residual stresses due to the heavy restraint of tack welds and final welds. This method has a further disadvantage in that all welds are made in position. This naturally involves considerable awkward welding in vertical and overhead positions. The welds can be placed in these positions with sound results, but the cost is high compared with that when the welding is done in the flat or downhand position.

The second fabricating procedure does not employ rigid tack-welding or clamping, and permits of all welds being made in the downhand position in what is, in effect, a 90° V-groove.

The design of the structure has a great bearing on its weldability. It is trite to state that the designer should, if possible, dispose all material and welds symmetrically. The welds should be proportioned with an eye to the sizes of the material they connect and to the type of loading.

In order to describe the procedure clearly, actual applications will be outlined in detail.

Welded Pier Member Cited as Example of Procedure

Figs. 2 and 3 show details of a large pier member or shoe required for a suspension bridge. One of these shoes is required between the concrete pier and the base of each tower leg. Study of the drawing will show that the member is of considerable size and that the material used is comparatively heavy. All welds are ½-in. continuous fillets, placed as shown in the drawing. Due to the fact that machining allowances were small, when the size of the member is considered it is apparent that the fabrication and welding must be carried out to close tolerances. The procedure used was as follows:

The fabrication was divided into two main stages: the central "grid" structure, and the complete assembly. The grid structure in turn was split into three parts: a right and left grid section and a center section. This sectionalizing of the grid allowed several welders to work simultaneously, and almost eliminated any cumulative effect of stresses and distortion due to welding that would have existed had the whole grid been tacked into one large piece.

All plates were flame cut, and planed on their vertical edges. Each grid sec-

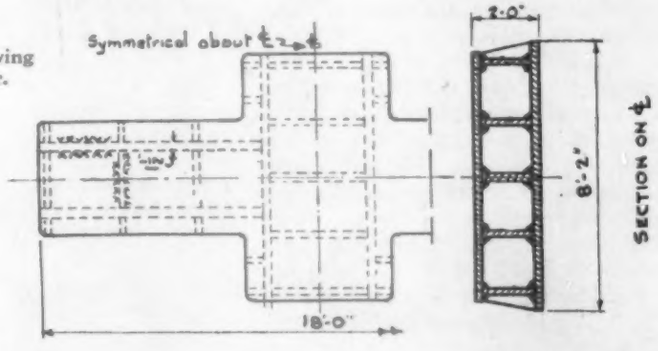


Fig. 3. Plan Drawing of Pier Member.

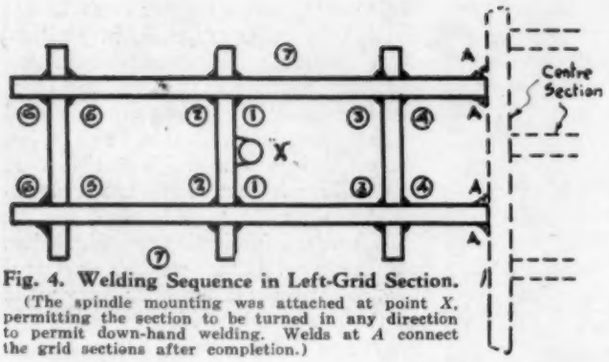


Fig. 4. Welding Sequence in Left-Grid Section.
(The spindle mounting was attached at point *X*, permitting the section to be turned in any direction to permit down-hand welding. Welds at *A* connect the grid sections after completion.)

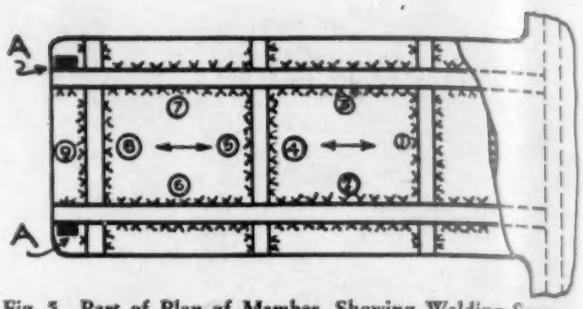


Fig. 5. Part of Plan of Member, Showing Welding Sequence.
(The grid section is not rigidly tack welded to the heavy cover plate, but is located in position by guide blocks *A*, which permit relative movement of the grid section and plate during welding.)

tion was then rigidly tacked and mounted on a spindle which was connected as close to the center of gravity of the piece as possible. This spindle was mounted horizontally, thus bringing all welds, which appear as vertical welds in the finished structure, into a horizontal position. The mounting fixture permitted the welder himself to manipulate the piece on the spindle by hand and so to position it that all welds were made downhand in a V formed by abutting plates.

Fig. 4 indicates the sequence of welding the right- and left-hand grids. The center grid sequence was similar. The spindle mounting was attached at the point *X* in the sketch.

Grids Were Welded as Free Units, Then Assembled Together

It will be observed that inherently the grids themselves present little difficulty. They are "free" structures, in that each part can move freely while welding. It is well to note, however, that, due to the heavy continuous fillet welds used, there was a longitudinal shrinkage of about ⅛ in. in each grid. This was allowed for when cutting and machining the plates. All welds were made in two layers or passes, using ¼-in. covered electrodes and a current of 300 amperes. The grid sections after completion were brought together, and welds at *A* were made connecting them. The completed grid section, 18 ft. by 8 ft. by 2 ft. deep, was now stress-relieved by heating the structure slowly in a furnace to 1200° F. and holding it at that temperature for 2 hr. The member was allowed to cool in the furnace.

The stress-relieved grid was next placed on a planer and planed top and bottom. The top cover plate, 87½ in. by 1¼ in. by 17 ft. 0 in., was then assembled to the grid. No tack-welding was done at any point on either the top or bottom cover plates. The plate was clamped in place by bolts and located with respect to the grid by small locating blocks welded to the cover plate. These blocks are indicated in Fig. 5 and can be seen in Fig. 3.

Consider the conditions illustrated in Fig. 5. A grid section which is by nature rigid is to be attached by welds to a heavy cover plate which is also rigid. The transverse welds (1), (4), (5), (8), and (9) cause a very marked shrinkage in the cover plate in a direction at right angles to their length, as indicated by the arrows. They do not, however, exert a corresponding shrinkage stress on the comparatively thin transverse diaphragms. If the parts are tacked together rigidly, then severe stresses are set up in both plate and welds. By applying guide or locating blocks as indicated at *A* in Fig. 5, this difficulty is readily surmounted.

While welds (1) and (5) were being made, the cover plate, which, due to these transverse welds, is compelled to contract and move relative to the grid, is free to do so since the locating blocks do not restrain it in any way. If the parts were held rigidly together the transverse welds would have to resist the resultant of two stresses—longitudinal and transverse. The procedure is followed out as indicated in Fig. 5, until the center section of the grid and top cover plate are completely welded.

Shrinkage Due to Longitudinal Welds Was Small

A study of Fig. 5 will naturally raise a question as to the stresses occurring in the longitudinal welds numbered (2), (3), (6), (7), &c. These welds are made on a fixed and rigid structure and are apparently not benefited by the freedom of relative motion between the grid and the cover plates. This difficulty was noted and tests were made on full-size sections to determine the relative shrinkage of grid plates and covers due to the longitudinal welds. These showed that the grid-plate shrinkage was double that of the cover plate due to the longitudinal welds. This is a different condition from that encountered due to the transverse welds, and since the amount of shrinkage involved due to the longitudinal welds was comparatively small it was decided that stresses would not be excessive. In addition, the sequence employed allows movement in the direction of shrinkage and the stresses are thereby minimized. This was borne out in practice and none of the welds developed cracks.

In welding structures of the type described, the sequence of welding of the final group of welds—those joining the top and bottom cover plates—must be such as to limit the distortion of the complete member.

The general rule is to make half of the welds on the top plate at the center and then make all the welds on the bottom plate. After the bottom-cover-plate welds were completed those remaining on the top cover were finished. This sequence eliminates distortion.

The whole member was now stress-relieved in the furnace and delivered to the machine shop for the completion of the work.

Maximum Warpage of 3/32 In. in 18-Ft. Member

It is of interest to note that the four members fabricated by the procedure outlined were remarkably accurate to dimension. The maximum error in the four members was a bow and warp of 3/32 in. in the 18-ft. length. The finished member weighed 10 tons after machining.

The above rather lengthy description of procedure requires some discussion. The salient points involved are:

(1) Resolution of the complicated member into a series of simpler, smaller

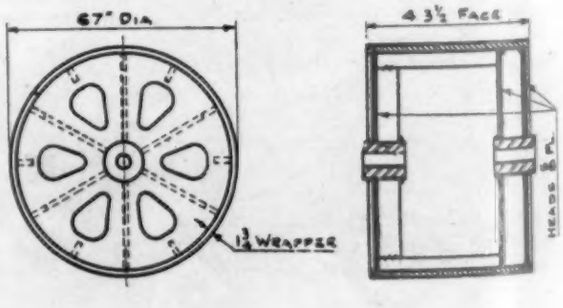


Fig. 6. Detail of Welded Drum for Vertical Lift Bridge.

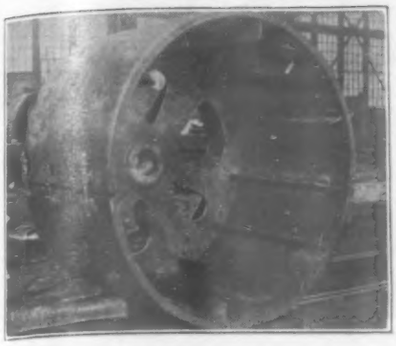


Fig. 7. Interior View of Drum, Showing One Head in Place.

sections. This procedure successfully limits distortion to small amounts in each section rather than risking a large cumulative distortion in the whole stiff member. It readily permits of small corrections being made to any sub-assembly to allow for distortion, before assembly into the complete unit, which permits easier handling and more flexible operation from a production viewpoint.

(2) Avoidance of rigid tack-welding in final assembly of cover plates and grids. This is a fundamental principle to follow when welding together two or more large, rigid sections to form a single structure. It will be readily noted that there is complete freedom of movement longitudinally between the cover plates and grid section, thus minimizing residual stresses and distortion.

(3) Due to this semi-flexible method of assembly, the awkward and expensive "staggered" or "step-back" welding sequences are unnecessary. Had the structure been rigidly tacked together, welding would have started simultaneously at either end and on both top and bottom cover plates. This would preclude positioning of the work at an angle of 45° and prevent advantage being taken of the higher speeds possible when welding in the flat or "downhand" position.

Large-Electrode Technique Applied to Drums

A further example of the successful application of this procedure and of "large-electrode technique" to the fabrication of large drums will be described.

The drum shown in Fig. 6 was one of four designed and built for service in a vertical lift bridge.

Due to considerations of cost and of limitations imposed by the bending-rolls available, the wrapper-plate thickness was held to a minimum. This fact rendered it necessary to work to very close tolerances in the welding shop while fabricating these drums. The procedure was as follows:

After Welding, Wrapper Plate Shrinks to Snug Fit on Discs

The wrapper plate was carefully rounded up in a hydraulic press after rolling. Careful measurements were made of the circumference of the wrapper after rolling and rounding up. The disc heads were then turned to suit their respective wrappers and were made so that they would be a "size and size" fit in the cylindrical wrapper *after* the longitudinal butt weld in the wrapper was completed. This point is worth attention. The disc heads were turned $\frac{3}{32}$ in. smaller than the nominal inside diameter of the wrapper. This permitted the wrapper to shrink snugly around the heads when the longitudinal butt weld was made. The calculated circumferential shrinkage of the wrapper due to the heavy butt weld was $\frac{3}{32}$ in. Dividing this figure by π gave the value of diametral shrinkage. By allowing the rim or wrapper to shrink freely before coming into contact with the heads, the bulk of the stress transverse to the butt weld (circumferential stress) was eliminated. No procedure, except peening, will relieve the longitudinal stresses in the heavy butt weld.

The shrinkage in the wrapper followed closely on that calculated, and resulted in an excellent fit-up between the wrapper and the heads. The heads, being turned, were therefore capable of rounding the wrapper into approximately a perfect cylinder. This was important, since the machining allowance on the outside diameter was $\frac{1}{8}$ in. all over.

No Distortion of Radial Stiffeners When Guide Blocks Are Used

Figs. 7, 8 and 9 show details of the procedure. Note the use of guide blocks on the heads (Fig. 8) when welding the radial stiffeners. Had these stiffeners been tacked rigidly to the heads, a great deal of buckling would have resulted. Welding was carried out from the hub to the outer edge or rim.

The foregoing pages contain a general outline of technique and procedure as used by the authors' firm in fabricating heavy weldings. The methods used have produced gratifying results, and it is in the hope that it may at least merit discussion that this paper is submitted.

Fig. 8. The Drum Discs Were Turned to Such a Diameter That the Shell, After the Shrinking of the Longitudinal Weld, Fitted Them Snugly.

Fig. 9. Another View of Drum, With Heads in Place, Ready for Welding.

Farm-Implement Contest Extended to End of Year

Because the wet weather has interfered with the use of plows and cultivators, the implement contest being run by C. E. Phillips & Co. and announced by them in previous issues of *The Welding Engineer*, has been extended to Dec. 31, 1935. Requests for such extension have been received from over 70% of those who have entered the contest, says J. C. Menzies, of the Chicago office of the company. The extension will make it easier to judge the winner, since thus far this year hard-surfaced agricultural implements have not had much opportunity to have their wearing qualities demonstrated. Blanks for entering the contest can be obtained from C. E. Phillips & Co., 324 S. Jefferson St., Chicago, Ill., and 5443 Twelfth St., Detroit, Mich.

Cleveland Will Be Hosts to I. A. A.

The International Acetylene Association will hold its 36th annual convention this year in Cleveland at the Cleveland Hotel on November 12th to 15th, according to an announcement just issued by the Association's secretary, H. F. Reinhard.

Speakers at the technical sessions will include prominent men in many fields of commerce and industry. New developments in the oxyacetylene process, and their application to industrial problems, will be discussed by leading welding engineers.

The unusual interest evinced by those who attended the convention last year has inspired the development of an even more extensive and comprehensive program for this year's meeting. Additional details and copies of the tentative program may be obtained by writing to the Association's headquarters at 30 East 42nd St., New York City.

Fig. 1. Burners at Work on Main Cable Anchorages.

(Chicago Daily News Photo.)

Dropping the Sky-Ride Tower

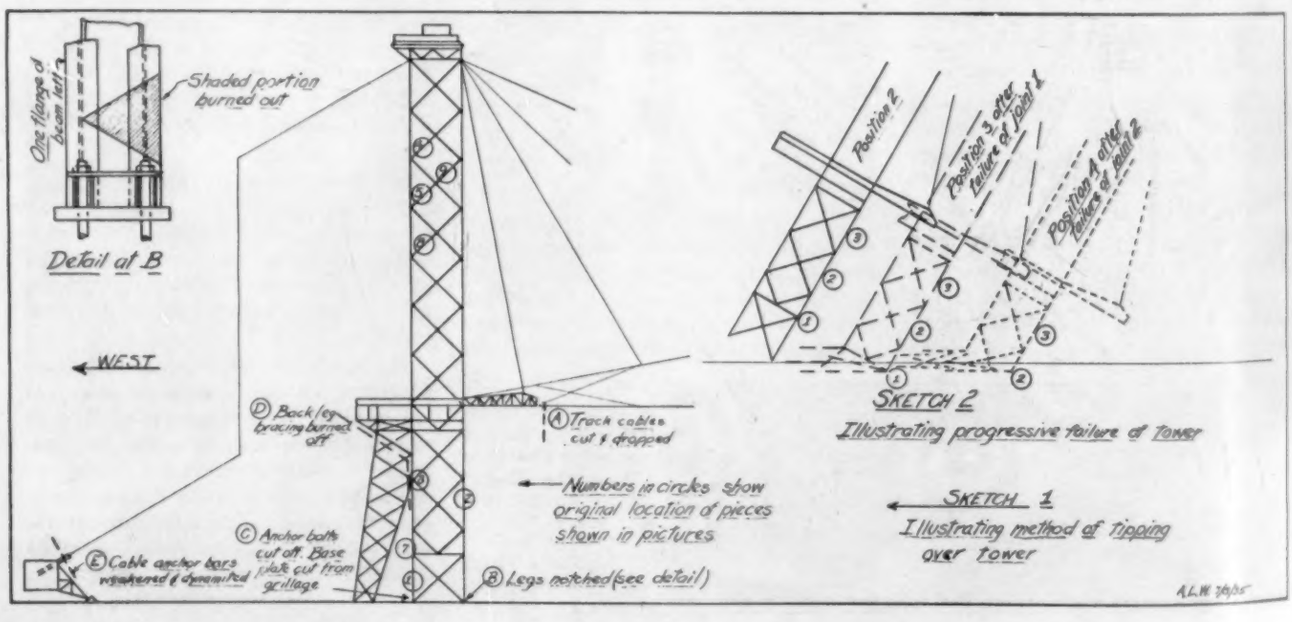
Including Notes Made During an Inspection of the West Tower After Its Demolition

■ By **A. L. WILSON**
Welding Supervisor,
Mississippi Valley Structural Steel Co.

IT HAS been argued that the only way to tell how much stress welding will withstand is to test to destruction pieces built up by welding. This is not usually possible. But the wrecking of the west tower of the Sky Ride (the outstanding structure of A Century of Progress, Chicago), on June 8th, furnished an unusual opportunity to observe what welding will and will not stand under a test that closely approached the ultimate strength of the material welded. Welding enthusiasts need offer no apologies for what was revealed by an inspection of the demolished tower. This tower, and its twin on Northerly Island, are 628 ft. high—the tallest structures west of the Alleghe.:y Mountains. The design of and construction of these towers by shop welding and field riveting was described in *The Welding Engineer*, January, 1933.

A short outline of the method used to upset the west tower will probably be of interest. In following this description, refer to sketches No. 1 and 2.

The elevator machinery, windows and any small movable objects were dismantled and removed from the tower. A tract was cleared between the west tower and the lagoon of all material that might fly when the tower crashed down. The track cables were cut off at the end of the trusses at point *A*. The back leg bracing under the platform at the ride level was burned free along the line *D*,


One flange of beam cut
Shaded portion burned out
Detail at B
WEST
D Back leg bracing burned off
A Track cables cut & dropped
C Anchor bolts cut off. Base plate cut from grillage
E Cable anchor bars weakened & demolished
B Legs notched (see detail)
Numbers in circles show original location of pieces shown in pictures
SKETCH 1
Illustrating method of tipping over tower
Position 2
Position 3 after failure of point 1
Position 4 after failure of point 2
SKETCH 2
Illustrating progressive failure of tower
A.L.W. 7/9/35

and the bracing was left standing. The next step was to burn notches in the east legs of the tower at point *B*. The anchor bolts of the west legs of the tower were next burned off at point *C*. The slabs upon which the columns rested were burned free of the grillages, embedded in the concrete foundation. These slabs were welded to the grillages after the tower was erected.

The plan was to release the main stay cables simultaneously, thus causing the catenary cables to pull the tower down. The main stay cables were fastened to the west anchorage (at the south end of the Stadium) by eight 12x1½-in. plates, there being a pair of plates for each of the four main cable systems. These cables extended over the two towers to the east anchorage on Northerly Island. It was important that both groups of cables—those on the south and those on the north—be released simultaneously.

Cable Anchorages Notched With Torches, Then Dynamited

As a preliminary operation, two 6x½-in. slots were burned in each of these plates. Then on Saturday morning, June 8th, eight experienced burners, previously trained in their particular duties, completed burning the eight plates at point *E* until the slots were reached, whereupon each remaining bar, now reduced to 2x1½ in., elongated ⅛ to ⅛ in., indicating that the yield point had been passed.

Twenty-seven pounds of 60% dynamite was then packed between each of the four pairs of plates opposite the weakened section. The burning was started at 5:24 a.m. and completed 11 minutes later. The dynamite was shot at 5:52 a.m., releasing the cables. The tower fell due east, rotating about the bases of the two east columns, and breaking in the notches previously cut in the 20-in. I-beams, about 18 in. above the column bases.

Fig. 2. View of Upper 300 ft. of Tower Lying on the Ground.

(The bracing on the north and south faces of the tower has torn loose and buckled, permitting the west face to collapse onto the east face. At the top of the picture is the observation platform at the 600-ft. level, looking at the bottom. Part of the east tower, still standing, can be seen in the background.)

Fig. 3. This Heavy Column Was Bent and Twisted by Tremendous Forces.

(This is a portion of the northwest column, remaining in an upright position, and corresponds to point 1 in sketch No. 1. The bottom column section of this leg and of the other west leg were extra long, necessitating the splicing of the flange beams. The center or web beam was continuous throughout the section. Note that the gusset plate is torn at the flange splice and the web beam is broken in two at the same point, though here the web was 1⅝ in. thick. The welds connecting these three I-beams forming the column were broken except at the bottom.)

The failure of the tower occured progressively (see sketch No. 2). The corner columns were built in 50-ft. sections. The ends were milled and the joints made by means of riveted gusset plates. As the tower leaned over, an excessive load was thrown on the first splice above the base of the column at point *1*. The rivets in the splice plate sheared, dropping the remainder of the tower into Position 3. As the tower leaned further, the stress was thrown on the next higher splice. After the third splice failed, the stiffening truss dug into the ground, relieving the falling tower of the weight of the steel at the ride level. The remainder of the tower then dropped to the ground; and some of the joints were ripped apart, but not as regularly as in the first 200 ft.

Fig. 4. Typical Failure of Column Connection.

(See point 7 in sketch No. 1. In this column failure, the upper flange beam is torn in two and has been bent more than usual. Note in the lower left the sheared rivets where the gusset plate tore loose. The splice plate visible at the bottom sheared its rivets, apparently throwing the load on the opposite flange beam, causing the flange and web beams to be torn apart. The ⅞-in. rivet holes give an idea of the size of these sections. These column sections were welded with 2 ft. of continuous weld at each end and 4½-in. spots at 1-ft. centers, ½-in. bead being used near the base of the tower and ⅜-in. at the top.)

Welds Showed High Resistance to Destructive Forces

While the tower for the most part was pretty badly demolished, all sections of the same kind behaved much in the same way. Figs. 3 to 6 give a comprehensive idea of the condition of the column sections below the 200-ft. level (the ride level). From a welding standpoint, the most important fact is that in these occurred the bulk of the broken welds. I would not call this weld failure, however, because these were stitch welds, and they broke through the root, with few exceptions. The huge fabricated column section weighed 365 lb. per lineal foot at the base of the tower. Considering the size of these sections, it is easy to understand that the welds were never put on with the idea of tearing the sections in two.

We were particularly interested in finding weld failure. On the bottom section of the northwest column we found three stitch welds in a row that showed lack of proper penetration and had

Fig. 5. View of Broken Joint in Northeast Column.

(As the tower tipped over the rivets in the gusset plate sheared, resulting in a similar condition to that represented in Fig. 4. The flange beam, corresponding to that at point 3 in sketch No. 1, bends down from just below the center, at the right-hand edge of the picture. Note the condition of the brace strut with the end resting on the column. The end has been badly torn and jammed, yet the piece retains its shape and all the welds are holding. In the upper left of the picture is the under side of the work deck at the 200-ft. level, this having been made in sections of $\frac{7}{16}$-in. plates with channel stiffeners welded to the bottom; these did not receive sufficient shock to be injured. In Fig. 2, some of these plates are shown broken loose. These plates were welded with a ¼-in. bead, 3 in. at the end and 2-in. tacks every foot.)

Fig. 6. Broken Web Beam at Mid-Section of One of Columns.

(View of mid-section of a column, with the lower end buried in the ground. This corresponds to point 2 in sketch No. 1. In addition to a broken web beam, both flange beams are bent. The riveted batten plate is sheared at one end. The welds in the vicinity of this point broke through the roots.)

Fig. 7. Bent Diagonal Brace.

(See point 4 in sketch No. 1. None of the welds gave way except those at the ends of the tie bars used to hold the channels in position. The braces shown in this view, and those in Figs. 8, 9 and 10 were made up of a web plate and two channels used as flanges. The plates varied from 15x$\frac{7}{8}$ in. to 18x$\frac{5}{8}$ in. in size, and the channels from 9 to 15 in., standard weight. The plates and channels were welded with a $\frac{5}{16}$-in. bead, being 1 ft. continuous at the ends, and the remainder consisting of 3-in. stitches opposite at 9-in. centers. Note that the upper channel is folded over against the web; also the lower channel has its flange against the under side of the web. Even where the web plate is buckled, the stitch welds held.)

Fig. 8. Sharp Bend in Brace Strut.

(The channels tended to fold up against the web plate. The one stitch weld nearest the center of the buckle broke through the root. Whether the strut bent here because the stitch weld broke, or the stitch broke owing to the excessive stress at the time of bending, is undeterminable. The strut shown corresponds to that at point 8 in sketch No. 1.)

Fig. 9. Weld Pulls Piece Out of Web of Channel.

(The welds did not break, but one of them pulled a piece out of the bottom channel. At the top of the view, the channel is torn through the web next to the web plate and folded back, but no welds were broken. See point 5 in sketch No. 1.)

Fig. 10. View of Strut With One Channel Badly Bent.

(This is another example of a channel with holes in the web caused by the welds tearing out the base metal. See point 9 in sketch No. 1.)

These views of welded columns and struts are not intended to be typical, but they show members that were subjected to especially severe destructive forces.

sheared off along the face of the web. We also found one stitch on a brace that had sheared along the surface of the web plate. These four stitches were the only welds we were able to find that had neither broken through the root nor pulled out a piece of the base metal when the sections were torn apart.

Figs. 7 to 10 are representative of the bracing throughout the tower, both above and below the ride level. The manner in which the welds on these pieces held up, compared to the way the welds on the heavy column sections broke down, is probably due to the greater amount of weld in proportion to the inherent strength of the section.

The East Tower Still Remains on Northerly Island.

(It is planned to demolish this tower shortly, making it fall in a direction at or about due north.)

The columns between the ride level and observation platform were in good condition as far as the welds were concerned. Here the welds were larger in proportion to the size of the columns, and this part of the tower very evidently did not receive the strain that the lower part did. In several cases the columns were not even broken apart at the milled joints.

All welds were made with bare rod, no coated rod being used on the job. The fabrication of the main members was all done on automatic machines built by the Mississippi Valley Structural Steel Co. especially for this job. The only hand welding was on the stiffeners and tie bars on the brace struts.

Heat of Cutting Torch Increased Strength of Steel Plate

In burning the bars at the anchorages in two, which is described in the first part of this paper, a point came up which will be of interest to welders and burners. It has been supposed that it was unsafe to burn steel while under stress, the heat weakening the remaining metal, with the danger of its giving way suddenly. In order to test this, the engineers in charge of demolition took a piece of scrap angle and put it in a testing machine under stress. They carefully burned a slot in first one side and then the other, keeping the load central with the unburned portion. Calculating the stress at the time the piece let go, from the load, on the basis of the cross-section remaining, the steel was found to be under a stress of 96,000 lb. per sq. in.

The author is indebted to Frank Randall, consultant on demolition, for an explanation of the method used in dropping the tower.

To Make Survey of All Welding Literature

The Engineering Foundation has appointed a Welding Research Committee to initiate and conduct a critical review of the world's welding literature, also to render modest aid to worthy individual projects functioning under the Fundamental Research Committee of the American Bureau of Welding, and to sponsor specific research investigations. The project will be started by funds contributed by the Engineering Foundation supplemented by funds and services supplied by industry. The project is jointly sponsored by the American Institute of Electrical Engineers and the American Welding Society.

Among the first proposed activities of the Committee is a canvass of industry for the purpose of determining what services can be counted upon by the Committee in the formulation of a program which will most effectively utilize the total of the resources which will be available to it. These contributed services will doubtless be of various kinds: reviews of literature and translations of foreign-language articles which have been or are being made for private purposes; technical assistance, materials, and the loan of apparatus in connection with specific research investigations; and unpublished research data. A maximum of contribution in the form of such services can be made by industry at a minimum of additional cost.

It is also proposed to collect information from which can be prepared a list of research projects now under way and being planned that can be made available to the Committee. Suggestions will be solicited for research projects which are recommended for prosecution under cooperative auspices. Another plan being considered is the setting up of a clearing house for translations and abstracts dealing with welding literature so that unnecessary duplication may be avoided and a maximum of cooperation secured in the critical abstracting of such literature.

Communications should be addressed to Wm. Spraragen, American Welding Society, 33 West 39th St., New York, N. Y.

Welding Plays Part in Making Miniature Car

A miniature Ford automobile, built to exactly half scale and true in every detail, is being displayed by the Ford Motor Co. at the San Diego Exposition. The model is placed on the top of a large globe in the Ford Building and is set in slow rotation. Arc and gas welding played an important part in the construction of this model. The chassis, or frame, was made out of 1/16-in. sheet steel and was welded into the proper channel shapes and profiles. The fenders, radiator and parts of the body were of aluminum, largely cast in sections and joined with the oxyacetylene torch. Almost every part of the lower structure was constructed with the aid of welding.

The Scientific Engineering Co., 3426 S. Wabash Ave., Chicago, Ill., who built this model, specializes in this kind of work. Their welding department, they say, is the most useful department in their organization.

Model of Ford Automobile Made to One-Half Scale, With Considerable Welding Used in Its Construction.

Further Data on History of Oxyacetylene Welding

Some bits of history, supplementing that given by Orn Weirs in his article in the June issue of *The Welding Engineer*, has been made available by the Air Reduction Sales Co., successors to the Davis-Bournonville Co., who, as mentioned in the article, were pioneers in the development and application of the art of oxyacetylene cutting and welding in the United States.

The early cutting apparatus, made by attaching a high-pressure oxygen tube

Early Cutting Device Equipped With Tee and Two Regulators.

to a welding torch, required three hoses, but it was possible to cut the number of cylinders from three to two. F. E. Rogers, of the Air Reduction Sales Co., states that early in the development of oxyacetylene cutting, only one oxygen cylinder was used, this being equipped with a tee and two regulators, thus making two oxygen cylinders unnecessary.

With reference to the story regarding the cutting of port holes in armor plate at the Brooklyn Navy Yard, the Air Reduction Sales Co. states as their belief that Fred J. Maeurer, now with this company, was one of the first men, if not the first, to cut port holes by the oxyacetylene torch in armor plate at the Brooklyn Yard.

Those who were connected with the early developments in the oxyacetylene welding and cutting processes are not in agreement on all points, and this is particularly true with reference to dates. One of the earliest users of oxyacetylene welding was the Best Manufacturing Co., whose shops were at the foot of 25th St. and the Allegheny Valley Railroad, in Pittsburgh, Pa. H. O. Quartz, now welding supervisor at the Allis-Chalmers Manufacturing Co., Milwaukee, Wis., was employed by the Best Manufacturing Co. to make oxygen for welding, and also as a welder. This company was using a welding torch that was brought over from Europe by a Frenchman named Beltzer, who was a chemist. According to Mr. Quartz, Beltzer sailed from Brest, France, and arrived in Boston in the year 1903. His torch was used in the Fore River Shipyards, Quincy, Mass., and was operated by Art Fisher, to whom Mr. Quartz gives credit as being the first American oxyacetylene welder. This is the same torch that later was used by the Best Manufacturing Co. Mr. Quartz's complete story on this early history appeared in the *Applied Engineering Department Bulletin* of the Air Reduction Sales Co., dated Dec. 16, 1934.

Commenting, in this *Bulletin*, on Mr. Quartz's story, F. C. Whitney, who was sales and advertising manager of the Davis-Bournonville Co., states that in his opinion it was in 1904 instead of 1903 that the Fore River Shipyards started to use welding, and that the introduction of the Fouche torch in this country by Mr. Bournonville antedated by a short time the bringing over of the Delcampe torch by Mr. Beltzer. In Mr. Whitney's opinion, the Best Manufacturing Co., who used the Beltzer-Delcampe torch and a low-pressure acetylene generator, was among the very first, if not the first, concern to practice welding on a commercial scale. Later the Beltzer-Delcampe Co. was organized, and about 1906-1912 they were operating in Bridgeport, doing job welding and making and selling torches, according to Mr. Whitney, though they did not long continue as a factor in the growing industry.

A slightly different story of the connection of the Best Manufacturing Co. to the early history of welding comes down to us from Albert N. Reynolds, formerly of the Best Manufacturing Co. and now of the Power Piping Co., and is reported by J. A. Warfel, of the Air Reduction Sales Co., in the same *A.E.D. Bulletin* as that mentioned above. It was Mr. Reynolds' impression that George Best, of the Best Manufacturing Co., brought from Germany the first welding torch in 1905-1906, though he will not absolutely vouch for this statement. Mr. Reynolds was in charge of the first power pipe welding, and the company's first operations were the welding of necks, nozzles and flanges. Lawsen Klauss was the first to be in charge of oxyacetylene welding for this company.

Other dates supplied by Mr. Warfel include the introduction of welding into the plant of the Westinghouse Electric & Manufacturing Co. about Dec., 1908; the cutting of the wrecked Quebec bridge in 1907 or 1908, and the cutting up of thet Battleship *Maine* in 1910.

Early plants were also sold to the Pittsburgh Valve Foundry & Construction Co, Liberty Brazing & Welding Co., Pressed Steel Car Co., York Manufacturing Co., Custer Coupler Co., Blaw-Knox, and others.

The article by Mr. Quartz and the comments by Mr. Whitney and Mr. Warfel, all appearing in the Dec. 16, 1934, *Applied Engineering Department Bulletin*, also include some interesting information on the early methods of generating gases for welding.

Uses Scrap Rails in Building Baling Press

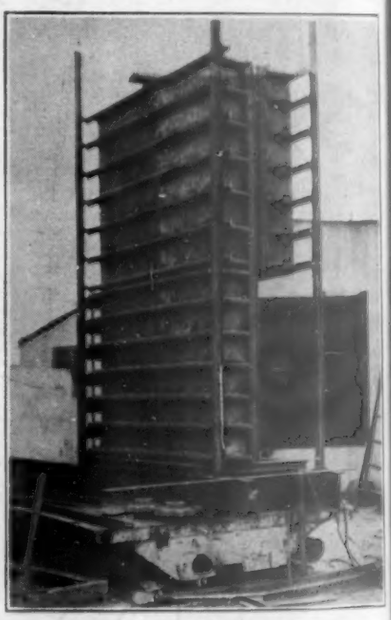
Through the use of a quantity of used 35-lb. rails taken from an old abandoned street-car line, and by means of electric welding, approximately $1500 was saved recently in the construction of a press for baling waste paper.

The illustration shows the press in the course of construction. It was built by the Acme Pipe Co., of San Diego, Calif., for a local salvage dealer, has a total weight of about five tons, and is 10 ft. high, 42 in. wide, and 6 ft. long.

The base is of 12-in. I-beams with corner end supports, side ribs, and bottom supports of 35-lb. rails, all electrically welded with 5/32-in. rods. The liner material for the press is of ¼-in. boiler plate, to which the side and end ribs are welded intermittently, making about 4-in. welds every 6 or 8 in.

A cutting torch was used to cut and fit the heavy steel rail members and to cut the sheet steel lining material.

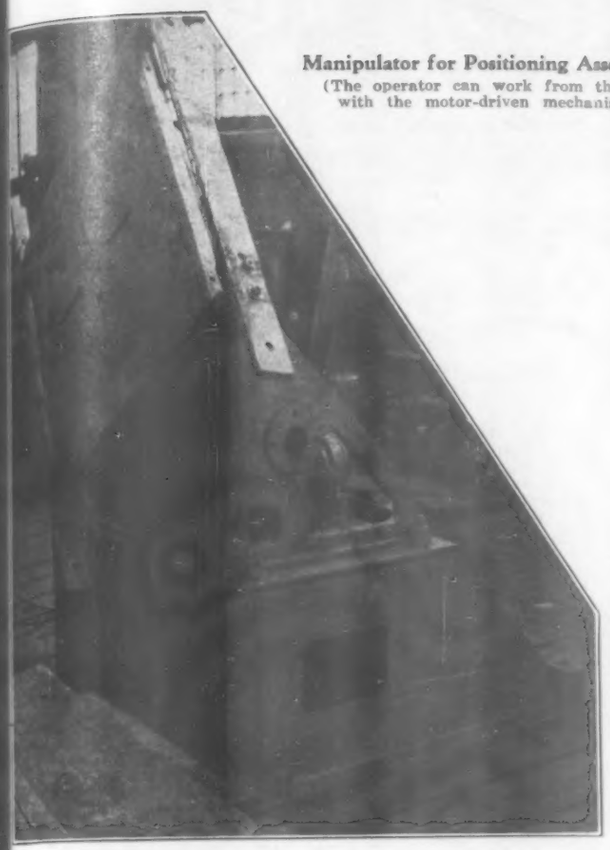
The heavy material from which the press is constructed, together with the



Baling Press Welded Up From Scrap.

welded construction, gives the press considerable added strength and sturdiness over one of the factory-built type, the owners claim. Also a factory-built press of the type and capacity of this one would have cost about $2000, whereas this press was built for less than one-fourth that amount.

This press has a working capacity of from 30 to 40 tons, and turns out a bale 30 in. by 30 in. by 6 ft., weighing from 850 to 1,200 lb.



Manipulator for Positioning Assemblies to Be Welded.
(The operator can work from the floor or ride the job, with the motor-driven mechanism under his control.)

Positioning Steel Assemblies for Welding

■ By ROBT. E. KINKEAD
Consulting Engineer, Welding,
The United Engineering & Foundry Co.

POSITIONING an assembly of steel parts for arc welding so that the welding may be done in the downward position is a means of reducing the labor cost of the welding operation. An additional advantage is found in the fact that proper fillet contours may be obtained with the job so positioned. Where the job may be easily and quickly positioned, a sequence of welding may be carried out which gives minimum deformation of the welded assembly after the welding is completed.

Weld Metal Can Be Deposited Faster When Job Is Positioned

Fig. 1 is a graphical representation of the effect of positioning the job on the rate of depositing weld metal. The "no positioning" figures are for making a fillet weld between two members joined at right angles with one member horizontal and the other vertical. Using coated rod 5/32 in. in diameter, and 150 amperes in the arc circuit, a fillet weld may be obtained which is fairly satisfactory as to contour. This represents the maximum amount of heat which may be applied and still get a fairly satisfactory fillet contour. If the job is tipped 20°, a ¼-in.-diameter coated rod and 175 amperes may be used and we still get a satisfactory contour, but this, again, represents the maximum heat that may be applied. More heat could be used, but the result would simply be waste of metal and power by making one leg of the fillet longer than the other. Tipping the job to 45° permits the use of 5/16-in. diameter covered rod and 350 amperes with perfect fillet contour. The legs, under these circumstances, will be equal, root penetration excellent, and the margins of the weld free from undercut.

It will be observed, from the above, that the rate of depositing weld metal for the full-positioned job is about five times the rate for the job when not positioned. But, this is not the full story so far as cost is concerned. With proper manipulator equipment for quickly positioning the job, the operator will actually weld more minutes per day. He does not have to wait for a crane to re-position the job; he does it himself. In general, positioning the job will permit an increase in rate of depositing of metal of from two to five times, in addition to an increase in actual welding time of 50% to 100%.

The accompanying table shows the effect of positioning on the time required to get a welding job done. Figures are given on jobs requiring from 50 to 1000 lb. of weld metal to be deposited. It is assumed that the operating factor is 60%, which is about right for welding done on an incentive system. On day-work rates this factor would be only about 30%. The operating factor is obtained by dividing the actual welding time by the elapsed time the man is on the job.

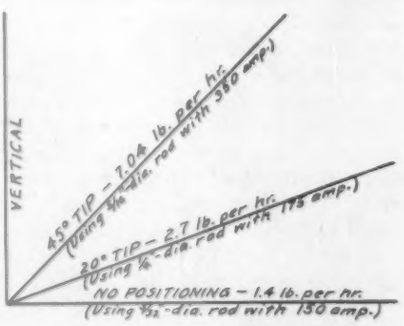
Time Required to Weld in 90°, 20° and 45° Positions.

Weight of Weld Metal	—Time to Weld, Hr.— 90°	20°	45°
50 lb.	36	19	7
100 lb.	71	37	14
150 lb.	107	56	21
200 lb.	142	74	28
300 lb.	213	111	42
400 lb.	284	148	56
500 lb.	355	185	70
1000 lb.	710	370	140

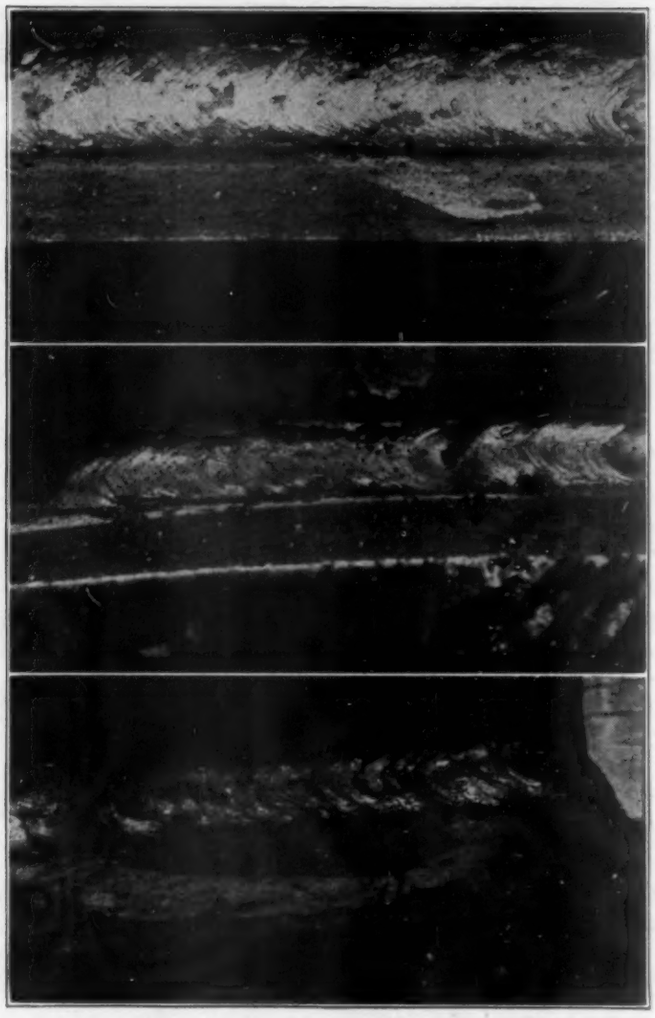
Work Is Also Speeded Up by Proper Positioning of Job

It is at once evident that positioning the welding job speeds up the work through the shop. Less floor space is required to get the same output, because the work moves faster.

Fig. 2 shows the appearance of the fillets made with currents and rod sizes given in Fig. 1. The fillets, it will be noted, are of satisfactory appearance,


VERTICAL
45° TIP – 7.04 lb. per hr.
(Using 5/16-dia. rod with 350 amp.)
20° TIP – 2.7 lb. per hr.
(Using ¼-dia. rod with 175 amp.)
NO POSITIONING – 1.4 lb. per hr.
(Using 5/32-dia. rod with 150 amp.)

Rate of Depositing Weld Metal, With Job Held in Various Positions.



Fillet weld made with 5/16-in.-diameter coated rod and 350 amperes. Work tipped 45°. No weaving.

Fillet weld made with ¼-in.-diameter coated rod and 175 amperes. Work tipped 20°. Slight weaving done to get equal legs.

Fillet weld made with 5/32-in. coated rod and 150 amperes. Work not positioned. Approximately equal legs of the fillet are obtained by weaving.

Fig. 2. Views of Fillet Welds Obtained With Work Located in Three Positions.

although the one made with the 5/16-in. rod and 350 amperes is more desirable than the others.

The illustration at the top of the preceding page shows the "manipulator" manufactured by The United Engineering & Foundry Co., First National Bank Building, Pittsburgh, Pa. The particular unit illustrated handles 13,000 lb., with the center of gravity 12 in. from the top of the table. Larger units to handle 40,000 lb. at 30 in. from the top of the table are in course of construction. The table of these units can be tipped as much as 90° forward and 45° backward, and can be revolved 360° in any tipped position. The gear mechanism is motor driven and is controlled by pushbuttons on the end of a cable. The operator can work from the floor or ride the job. The necessities of safety in machinery of this kind require that an ample factor of safety be incorporated into responsible parts, since it is easy to imagine what would happen in the case of stripping of a pinion or shearing of a shaft with a heavy job tipped in the 45° position.

The present necessities in welded steel machinery parts and structural assemblies made in the shop are: reduction in cost, improvement in appearance, rapid movement through the shop. The use of the "manipulator" contributes greatly to the attainment of these purposes.

Tank Explodes When Purging With Steam

When purging a tank car or other large container with steam, using a rubber steam hose, the hose should have the coupling removed at the free end.

In *Chemical Safety,* issued by the Chemical Section of the National Safety Council, an accident is described in which a workman was using a steam hose with an iron coupling at the end to steam a tank car that had contained gasoline. He turned on the steam, and immediately an explosion occurred, throwing him off the side of the car. It is thought that the sudden application of steam pressure whipped the metallic end of the hose against the inside of the tank, causing friction sparks. A coupling of brass might be substituted for the one of iron to eliminate such accidents, or a rigid pipe used instead of a flexible hose.

Kansas Conference Stirs Up Interest in Welding

At the University of Kansas' first welding conference, held in Lawrence, Kan., June 27th and 28th, the attendance held up to around 80 at all sessions, and a high degree of interest was shown in the general program. A great many local people and outsiders attended the demonstrations on welding, cutting and metal-spraying held in Fowler Shops on the evening of the 27th. Prof. A. H. Sluss was in charge of the program.

H. C. Price Gets Contract for Welded Pipelines

The electric welding of 88 miles of 10-in. oil line for the General Pipe Line Co. from Lebec to Torrance, Calif., has just been completed by H. C. Price, Inc., of Los Angeles, Calif. The welding was completed in 65 working days, employing three gangs. Seamless pipe with double bell joint and backing-up ring was used. Macco Robertson and Lang Transportation Co. were the general contractors.

Contracts for two more pipeline jobs were recently received by the Bartlesville, Okla., office of H. C. Price, Inc. One involves the electric welding of 180 miles of 8-in. gasoline line from Harrisburg to Pittsburgh, Pa., for the Keystone Pipe Line Co., work on which has already started. The Marathon Construction Co. are the general contractors. The

Making Bell-Hole Weld in 10-In. Oil Line Between Lebec and Torrance, Calif.

other job is an 8-in. oil line, 28 miles long, in the vicinity of Ada, Okla., on which construction has begun. Lemons & Bradley, Inc., are the general contractors.

Safety Rules and Precautions

in the Use and Handling of Oxyacetylene Equipment and Gases . . .

THE following do's and don'ts are intended to supplement the usual precautions given for the operation of oxyacetylene equipment. Many of these rules pertain to the unusual type of case that is not generally covered in printed instructions. These rules are printed herewith through the courtesy of the Air Reduction Sales Co.

Oxygen, Cylinders, Pipelines and Manifolds

1. Make sure that no oil can leak from floors above onto oxygen cylinders or apparatus.

2. Never use oxygen in place of compressed air as a pressure medium to blow out obstructed pipelines, to operate pneumatic tools or to build up pressure in tanks containing oils or other inflammable materials.

3. See that all oxygen and acetylene pipelines are free of leaks. Lines must be blown free of dust, rust and all combustible matter, especially carbonaceous matter and oil.

4. Nitrogen is the preferred gas for blowing out pipelines, but clean compressed air, free of water or oil, may be used.

5. Oxygen and acetylene cylinders should not be transported lying down on small automatic electric factory transportation trucks with cylinder valves overhanging in position to catch stationary objects. Cylinders should stand upright. Caps should always be on cylinders when being transported.

6. Oxygen must never be used to blow dust out of clothing or to freshen the air in closed places. Serious burns may result from such practices.

7. Never use homemade manifolds constructed from screwed pipe and fittings. Such devices are highly unsafe.

8. Pressure regulators should never be changed by workmen with greasy hands. Operators in scrap yards or wrecking plants should be advised of the hazards of such practice.

9. Never test the pressure in an oxygen cylinder by holding a gloved hand over the nozzle. An oil-soaked glove may take fire and cause the loss of one's fingers by severe burns.

10. Do not use oxygen to operate a paint-spraying device.

11. Never apply a leather washer to a defective oxygen-regulator connection nor to any other part of oxygen apparatus.

12. Pipelines should be welded and hammered full length to loosen scale. All scale and other debris should be blown out before connecting valves, manifolds, etc.

13. Remove all sharp burrs from the ends of pipe to be welded into an oxygen pipeline.

14. When loading oxygen cylinders on trucks for delivery to customers, point the valve ends forward, preferably. They are not as likely to sustain valve injuries in this position.

15. Always refer to oxygen as oxygen, and acetylene as acetylene. Serious mistakes have resulted from calling oxygen "air," and acetylene "gas."

16. Do not place oxygen cylinders behind or near furnaces, boilers, or other sources of high temperature, or hot metal.

Acetylene, Cylinders, Pipelines, Stationary and Portable Generators, and Manifolds

1. Always keep the acetylene-cylinder valve key or wrench on the cylinder while in use. Never open an acetylene cylinder valve more than one full turn; then in case of fire the valve can be closed immediately.

2. Do not place acetylene cylinders near furnaces, boilers or other sources of high temperature, or hot metal.

3. Acetylene pipelines should be free from all leaks and of approved construction with proper safety devices throughout.

4. Never attempt to drain an acetylene cylinder by placing it close to a stove or a furnace. Let cylinders warm slowly in cold weather to room temperature to permit full discharge of gas.

5. Oxygen and acetylene pipelines should be distinctively painted or stenciled to indicate the character of the gases conveyed.

6. Cylinders with leaky valve stems should be tightly closed and returned to the filling point with a card attached explaining the defect.

7. Never inspect an acetylene generator with an open flame or an unprotected incandescent lamp.

8. Do not use an iron or steel bar for tamping carbide when filling an acetylene generator.

9. Always discharge the water and sludge whenever the generator is recharged with carbide. Refill the reservoir with clean water to the proper level before starting the generator into operation.

10. When filling the generator, never throw the carbide cans or covers onto concrete. Spark thus produced may cause an explosion.

11. Acetylene pipelines and generators should be overhauled and cleaned once a year to remove lime deposits. In cleaning out valves, use a hose or a brass rod —no steel, which might cause a spark. No open lights can be used on the job.

12. Acetylene pipelines should be provided with a pressure regulator at each station. This applies to small plans as well as large ones.

13. Stationary generators should be in charge of one employee, who will be held responsible for safe operation. Helpers appointed to assist in charging, discharging sludge, handling carbide, etc., should be subject to his authority exclusively when assigned to this work. No others should be permitted in or near the generator house except when required for special assignment.

14. Exercise great care when dismantling generators that have been out of use for some time. Gas may be trapped under dry lime deposits.

15. Portable generators should not be moved with carbide in the hopper, unless provided with positive means for preventing carbide from being shaken down into the water and generating gas.

16. All those who operate stationary acetylene generators should be adjudged competent by their superiors to assume this important work, as regards intelligence, sobriety and conscientious adherence to rules and instructions for the care, maintenance and handling of acetylene generators, furnished by the manufacturers.

Pressure Regulators, Gauges, Seats and Safety Discs

1. Always release the regulator adjusting screw before cracking the cylinder valve.

2. Use standard manufactured parts when renewing seats, discs and related parts.

3. Handle pressure regulators carefully to avoid breakage of gauge glasses and disarrangement of sensitive mechanism.

4. Keep regulators absolutely clean and free of oil and grease.

5. Don't use coarse emery cloth to clean seat nozzles. Use a pencil eraser

instead. Nicked seat valves should be replaced.

6. Do not use copper discs or other make-shifts as safety discs.

7. Do not cover freezing regulators, as the exclusion of the air aggravates the trouble.

8. Do not use a torch flame to warm up a freezing regulator; it is dangerous.

9. Do not decrease or release the pressure-regulator adjusting screw unless the torch valve is open.

10. Insert the dust plug in the regulator union nut when the regulator is not connected to the cylinder valve.

Hose, Hose Lengths and Hose Connections

1. Avoid splicing oxygen and acetylene hose wherever possible. Every splice or connection represents a possible leak.

2. Watch for worn and burned places in the hose lengths, or any damage that might cause a leak. A small leak and a spark from welding or cutting can cause a disastrous fire. Test all welding and cutting hose periodically in a tub of water under gas pressure.

3. Avoid the use of excessively long lines of standard-size hose. If lines of more than 150 ft. must be employed, provide ⅜-in. hose or larger to prevent excessive pressure drop.

4. Protect long hose lines from being trampled on or run over by trucks.

5. When replacing a hose connection, always cut off the old hose so connection is made in comparatively sound hose.

6. Always blow out the chalky substance inside new hose before attaching to the torch.

7. Hose connections as well as regulator connections should always be set up with a wrench. Don't depend on hand-screwed nuts alone.

8. Never use hose for oxygen that has previously been used for acetylene or other fuel gas.

9. Don't make a splice in an acetylene or oxygen hose with copper tubing or iron pipe; use brass or bronze.

10. Don't wrap a leaky hose with tape; cut out the leaky section and put in a splice properly clamped.

11. Never do welding with hose lying between the legs or around the neck when it can be avoided.

12. Hose glands can be made to stay put in hose and never leak by heating them in hot water before inserting in the hose. Clamps then applied will make a permanent connection. Hose in which a flashback has occurred should not be used again.

Welding Torches, Cutting Torches, Cutting Attachments, Tips, Mixers and Valves

1. Keep all welding and cutting apparatus in good condition, both for efficiency and safety.

2. Make sure when assembling the torch to hose lengths that the connections are tight and that the needle valves are free of leaks.

3. Keep the welding and cutting tips in separate containers to protect from jams and bruises. Never put oil or grease on a tip seat.

4. Mixers should be periodically cleaned to remove carbon. When not in use, they should be kept safe from bruises and oil contamination.

5. Do not clean tips with steel wire. Use tip-cleaner drills of correct size, or copper wire.

6. Close needle valves with a moderate thumb pressure. Never use a wrench to stop a needle-valve leak.

7. Keep the ends of tips free of slag and carbon.

8. Don't use tapered cleaners to clean tips. They are likely to enlarge the bore and spoil the tip.

9. Be sure that the cutting attachment is clean and in good condition before connecting it to the torch. Set the nut up snugly with a wrench. Purge with both gases before lighting.

10. Release the gas in the hose by opening the needle-valves before starting up in the morning. If the outfit was not properly shut down the night before, "dead" gas in the hose is very likely to cause a flashback if not blown out beforehand.

11. Never hang a torch with its hose onto the pressure regulators or cylinder valves.

Setting Up, Adjusting Pressure, and Lighting Torch

1. Do not open the acetylene-cylinder valve to blow dust and dirt out of the nozzle when in confined space or near highly combustible materials. Wipe the seat and nozzle with clean cloth instead.

2. Blow out the hose always, before connecting it to the torch, and make sure that there are no leaks at the connections.

3. Always when lighting the torch, turn on only the acetylene valve.

4. Always crack the oxygen-cylinder valve before attaching the pressure regulator, or carefully clean the valve nozzle and seat with dry cloth.

5. Light the acetylene first, and open the needle valve so the flame burns slightly away from the tip, and then turn on the oxygen to bring the flame to the desired characteristic. Pressures must be adjusted at the regulators according to the manufacturer's pressure table.

6. Always purge the hose and the torch by letting gases flow through before lighting the torch.

7. Always set the regulator pressures with the needle valves open. The correct adjustment cannot be made unless gases are flowing.

8. Do not light a torch with a cigarette.

Closing Down, and Closing Down for the Day

1. Removal of pressure-regulator screws and acetylene-cylinder keys, and placing under lock-and-key, will usually prevent unauthorized or illegal use of welding outfits out of working hours.

2. Close valves on the cylinders when the torch is to be out of use for some time, in addition to releasing the regulator screws. Release all pressure from the regulators when closing down for the day.

3. Close all oxygen and acetylene cylinder valves when the cylinders are discarded as empty. This rule should be strictly enforced, including replacement of cylinder-valve caps and marking or otherwise indicating that the cylinders are empty.

4. When closing down, always shut the acetylene needle valve first, then the oxygen valve. Shut off the cylinder valves, then open the acetylene needle valve and reduce the pressure to zero. Repeat with the oxygen needle valve.

5. Don't leave a small acetylene flame burning at the tip while re-arranging the work. It sets up a flashback hazard and also fouls the tip with carbon.

6. Make sure that no sparks or fire is left to smoulder in the cracks of wooden floors or in heaps of combustible materials nearby.

Moving Welding and Cutting Outfits

1. Close the cylinder valves tightly and release the regulator screws when moving outfits, even for only a few feet.

2. See that the cylinders are securely chained to the truck and that they cannot shift their position from sudden jar and thus bring pressure regulators into contact or otherwise unduly stress the connections.

3. Always close the cylinder valves and disconnect the pressure regulators from cylinders when making long moves with the outfit.

4. Hand trucks designed for welding and cutting outfits are not only a means of transportation, but are safety devices, and should be so regarded.

General Precautions, Clothing, Shoes, Gloves and Goggles

1. Provide small fire extinguishers or non-burnable blankets for the use of welders when working near combustible materials. Small fires extinguished prevent big fires.

2. Never wear low shoes, or trousers with cuffs unprotected with overalls, when welding or cutting.

3. Always wear goggles that fit the face and protect the eyes, and take time to put them on properly. Do not take a chance with your eyes. Profit by the experiences of others who have lost an eye or their sight completely by taking chances.

4. Do not lay a lighted torch down where it is likely to ignite combustible materials. Always shut off the gases, is a safe rule to follow when relinquishing a welding or cutting torch.

5. Wear clothing that protects the arms and body from sparks.

6. Gloves should be of heat-resisting and heat-insulating material, calculated to wear well, to prevent serious burns or blisters.

7. Overalls or coveralls should fit closely around the neck and wrists to exclude sparks.

8. When making demonstrations in street clothes, it is wise to turn the cuff of one's trousers up inside to avoid having sparks lodge in the cuffs and burn holes in them.

9. Canvass leggings and sleeves have been found useful on heavy, hot jobs. They do not burn easily and are good protectors from sparks and heat.

10. Don't use cheap colored glasses with celluloid frames. Don't wear celluloid collars. Serious burns may result from such apparel.

11. Avoid rawhide gloves on heavy, hot jobs. They may cause blisters.

12. Never cut into tanks, drums, etc., without ascertaining prior contents. If they contained oil, gasoline, or other highly combustible fluid, insist on purging, steaming, or other protection from explosion before using the torch.

13. Never point a torch flame toward a helper or an inflammable object.

14. Do no cutting over a concrete floor without laying a steel plate or other suitable non-inflammable protection on the floor to prevent the hot slag from falling on the floor and causing damage.

15. Do not undertake to weld or cut with oxyacetylene in air locks or caissons under considerable air pressure.

16. Do not use a partly discharged acetylene cylinder to supply a large welding or heating tip for outdoor work in very cold weather. Use filled cylinders stored for several hours in warm rooms.

Government Wants a Senior Metallurgist

An open competitive examination for the position of senior metallurgist, at $4,600 per year, has been announced by the United States Civil Service Commission, to fill a present vacancy in the position of Senior Engineer (Materials) in the Ordinance Department, and other vacancies that may develop. Applicants may obtain the necessary forms by writing the United States Civil Service Commission, Washington, D. C., asking for forms for the examination for senior metallurgist. Applications must be filed with the Commission not later than July 20, 1935.

Get "*H. O. T.*" on Welding

■ By H. O T. RIDLON

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

We Live Again With Our Sons

Summer is now with us. School is out. The boy is looking for a job. What are we doing to help him? It is hard to ask the boss, for we are not very sure of our own job. Or we don't want to put him to work in our own shop because for the past few years we have been having our own troubles keeping a roof over the heads of those that depend upon us and beans on the table. There really isn't room for two of us there, and we really want to give the kid a break. But how? We don't want him to experience the things we have known. But where to get him a job? So many people we know have been out of a job so long that it seems almost hopeless to help that boy of ours. Where can we find him the right opportunity? Let's look at things squarely and honestly, and see what you and I can do for that boy of ours. We are in America, the land of great opportunities. Today there are forty chances for a young fellow where there was only one in the days when many of the men who today head great industries were in their teens or early twenties. When those young fellows found it time to go to work, the industries they head were many of them not born yet. And so it is today. Your boy may some day head some great enterpirse that is not yet born. And there are so many chances today that there is a great void for real talent at the top of nearly every industry. Let us teach him fundamentals, of industry, truth and honesty. Oh, yes, we have always tried to teach him those things. Sure you have, but you have been teaching all these years mostly what to think. Now let's teach him how to think. And then let him try to make up his mind what kind of a job he wants—what kind of business he likes, or thinks that maybe he likes. Don't get discouraged if he tries a dozen different ones. But get him into a job that he likes, that's fun for him. Something he can make a game of. Remember when he was a little fellow how hard he worked taking the old alarm-clock apart. Sure it kept him quiet for hours, but it was darn hard work for those little fingers, and yet what fun he had doing it, and what a great thrill of accomplishment there was in it for him. Remember his patient work in building with blocks, and years later putting the train-tracks together? Remember his early attempts drawing with pencil and crayon? But they were easy, for it was all a game. And when he can make his job a game, no matter how hard it is, he will really accomplish things and it will be easy. But then how to get him a job. It seldom is by looking in the paper, or going to all your friends and your friends' friends, because he doesn't know how to sell himself. Sure he's a grand lad, and they would love to give him a job now, but they just haven't any place for him, but they will keep him in mind and give him the first opportunity—maybe! And the weeks slip by into months and the months into years, and you wonder if you should make him join the army or navy, or go to a CCC camp, because you are having a hard time feeding him and there just doesn't seem to be any jobs for that fine boy of yours. In the meantime he becomes discouraged, and it all seems so hopeless. But that boy makes up his mind that he would like to be a groceryman. If he will find out all he can about the man who runs the BEST grocery store in town, and about his delivery boy, and if, after making sure about it, he will go to Mr. Grocerman and say: "I can deliver more groceries than your present boy, because of such and such reasons, and I am willing to start early and work later, because some day I want to own a fine store like this myself and be a fine, respected merchant like you are, Sir, and I know lots of people in this town that you are not getting their trade, and I feel sure that I can get them coming to your store"—well, sir, the first thing that lad knows he'll be working. Perhaps not steady, but he will be given a chance, and if he can prove his statements he will find that he is working steady. And if he makes the grade on his delivery end of the business and is bringing in orders he will soon be a clerk. If he does that job well, better than any of the other clerks, he will soon be manager, if he is a good buyer, and then he will shortly become a partner or own his own store. It doesn't make any difference what sort of a business that kid of yours picks, those facts still hold true. People don't want to employ just so much flesh and bone. There is plenty of that. But they do want to get the young men who will use those precious few ounces of brains they have.

The thought for the month: The man who works before he is hired, will soon find himself hired.

Welding on the All-American Canal Project

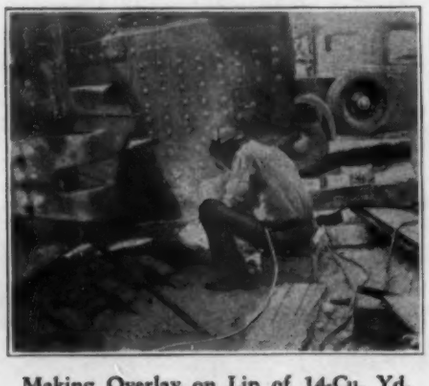
■ By JOS. C. COYLE

WELDING plays a very important part in the operations of all contractors engaged in the digging of the All-American Canal, in southern California, which is to carry irrigation water from the Colorado River to the Imperial and Coachella valleys in southern California, taking the place of a present canal which runs partly through Old Mexico. The project is an outgrowth of the Boulder Dam storage program, water for it being stored behind the dam. The main canal will be 80 miles long, 160 ft. wide at the bottom of the widest part, and 218 ft. wide at water line, with a minimum depth of 22 ft. The size will diminish as water is taken out at different points along the canal.

Large Draglines Negotiate Desert Sands and Silt

About ten miles of the canal will be dug through sand dunes which reach a depth of 80 ft., and much of the remainder is in soft sand and silt—a fact which brought about the use of three of the largest draglines in the West by the W. E. Callahan Co., the principal contractors, and the Boyce-Igo Co., subcontractors. Each machine weighs 650 tons and employs the walking principle, which is a distinct advantage in negotiating the desert sands. These are supplemented by smaller machines of the same type. The two largest machines of the Callahan company have 165-ft. booms and 12-cu.yd. buckets. The Boyce-Igo Co.'s largest machine has a 175-ft. boom and a 14-cu.yd. bucket.

Being familiar with the abrasive qualities of sand paper, one can surmise just what effect the desert sand will have to the many moving parts of machinery in use on the canal. This applies to a much greater extent, of course, to the big buckets, with the lip, the bottom and the rear corners especially subjected to abrasion. Arc welding is used to reinforce, patch and hard-surface these parts, and keep the monster draglines in operation day and night. A shut-down of one of these machines soon runs into big money. Unexpected breaks also occur. The welder comes to the rescue and gets the machine going again before replacements could be brought in.



Making Overlay on Lip of 14-Cu. Yd. Bucket.

A 12-cu yd. bucket formerly used by the Boyce-Igo Co. on the Mississippi levee was repaired and converted into a 14-cu.yd. bucket, on the job. In levee work it had been necessary to cut several rectangular holes in the back end of the bucket, as mud and water formed a vacuum and prevented dumping. These holes were plugged with sections of steel plate, welded inside and outside. The worn lip of the bucket was reinforced by the application of a section of 1-in. plate, 20 in. wide, to the bottom. One end was tacked in place, and the plate was then heated with oxyacetylene torches and bent into place around the corners with sledges, tacking down the edges as the work proceeded. The body of the reinforcing plate was secured to the bucket by countersunk rivets, and a continuous bead was run along the edges.

Reaming and Welding Operations on a Dragline Bucket.

At the front edge of this plate, where the bucket teeth are applied, about 140 lb. of rod was used in making the V-shaped weld, which averaged 3 in. wide and 1½ in. deep and was 8 ft. long. First, the surface was cleaned with a chisel and emery wheel, and welding was then carried on continuously, except that as a layer of metal was applied the surface was carefully peened and brushed with a wire brush while still hot and before the next bead was run. The weld was completed in 20 hours. The weld and a part of the bucket lip was overlaid with a ¼-in. hard-surfacing rod. This overlay was about 8 in. wide in the corners, where the hardest wear comes.

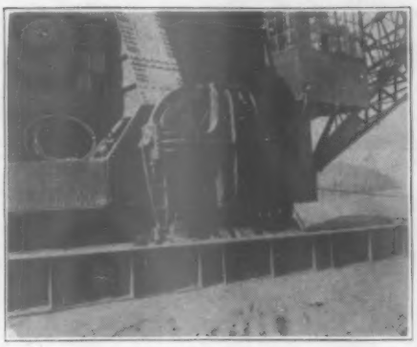
25-Cu. Yd. Buggy Dumping on Edge of Big Fill.
(The body, which is all-welded, has a capacity of 30 cu. yd. when used with sideboards.)

Cracks in Bucket Repaired by Welding on Plates

The constant strain of the drag cable on the jaws of the bucket had caused cracks where the drag-cable fitting is applied. This was repaired by bolting a 24x40-in. section of 1-in. plate to the inner surface to hold the edges firm while a similar plate was applied to the outside surface of the bucket jaw. This patch was welded along the edges, each bead being peened and brushed as it was run. The bolts were then removed from the plate and the body of the patch was riveted with countersunk rivets. A bead was then run in the crack on the inner surface of the bucket jaw, after the crack had been veed out with an air chisel and emery.

Welding is very generally used in repairing worn sections of these big buckets, manganese steel usually being employed as patches. One welder, who prefers an uncoated rod for this open-air work, says this type of rod fuses better where the cooling is rapid. In fact, the cooling effect of the desert breeze is one of the handicaps which must be reckoned

Arc-Welding a Reinforcing Plate Onto a Dragline Bucket.



View of Walking Eccentric on 650-Ton Dragline.

For Digging in Hardpan, This All-Welded Hook Is Used.

with in this work. A large sheet of old corrugated metal is often used as a shield to protect the weld from the wind while the work proceeds.

While on the levee work, before the contractor moved to California, one of the Waukesha auxiliary motors froze and the head and block cracked. The edges of the hole in the block (about 4 x9 in.) were beveled with emery and the edges of the broken piece were also beveled. The piece was then welded back in place, using a ⅛-in. copper rod, and skipping about so as to avoid setting up internal strains. A crooked bead about 8 in. long, made with the copper rod, repaired the crack in the head of the motor.

When the stand of one of the swing motors on one of the draglines cracked, it was repaired by veeing out the break with a cutting torch, to a maximum width of about 2 in., and then welding.

An 800-gallon water tank for one of the other draglines was built on the job by electric welding. It is 17½ ft. long, 23 in. wide and 36 in. high. Bottom and top sheets were of ⅜-in. steel plate, and the sides are of ¼-in. and the ends of ½-in. plate. The sheets were trimmed with a cutting torch to size and held in place by hand while being tack-welded. A continuous bead was then run along the inside and outside of the seams.

Repaired Eccentrics Have Been in Use for Several Years

When the draglines are walking from one location to another, the entire weight is thrown periodically on the two eccentric frames, one at each side of the machine. When something happens to cause one of these to break it is usually repaired by electric welding and put back into service. Sometimes it happens that operation of the machine has to wait for the repair to be completed, then the welder may have to work night and day until the job is done. Several of the eccentrics have been repaired in this way by the Callahan company, and some of the repaired frames have now been in use for several years since they were mended.

A typical repair job to one of this firm's eccentrics resulted from a mishap to one of the 650-ton machines while it was on Mississippi River levee work. Both the bottom race of the eccentric and the spiders were broken. The repair was made by first bolting a new race over the old one, as a guide to the repair work. The break was veed out with a cutting torch, then cleaned with chipping and bobbing tools in an air gun. A tent was set up over the work, and the job was preheated with charcoal for about 6 hours before starting to weld, reaching a temperature of 150° to 180° F. while welding was going on. Each course of the weld was applied about 3/16 in. thick, and was thoroughly scaled and cleaned with the air gun before the next course was applied. About 20 courses were required on some parts of the repair. Approximately 200 lb. of coated rod was used.

Procedure for Repairing Cracked Frame

The part was reinforced by a 3-ft. section of 4x4-in. steel on each side of the central part, also by the addition of a 4-ft. section of 2x2-in. steel to each side of the bottom of the race. Near the ends of the race it was also necessary to build up a section about 16 in. long of the 8-in. round portion of the race. About one-third of the circumference was covered with 3/16-in. high-carbon steel hard-surfacing rod. Small sections of plate were also welded in near each end of the frame to repair the cracked and chipped surface. The work was gradually cooled off, this requiring about 30 hours.

The two spiders for the eccentric frame were chipped out in the same way, and were reinforced by welding on a section of 4x1½-in. steel to each of the outer flanges, and a section of 1½-in. round steel to the edge of the inner flange. A similar section of round stock was welded to the flange at the end of each spider section. Preheating with charcoal pots was carried on for three hours before welding began, and the temperature brought up to 200° F., this being gauged by thermometers kept near the parts. This procedure was also followed in welding the races, previously described.

"Fish Hook" Made by Assembling and Welding Plates

In excavating the channel near Pilot Knob, a small mountain on the right-of-way, the W. E. Callahan Co. encountered frequent patches of cemented gravel which were too hard for the 12-cu.yd. bucket of the dragline to dig. For some time the procedure was to drill and blast these spots, meanwhile walking the dragline to another location. But the delay to the machine was expensive; so Major L. D. Crawford, vice-president of the firm, devised a gigantic "fish hook," as it is called on the job. This hook is 27 ft. long and the hook part is 6x8 ft. The hook is suspended from the boom of the dragline in the same manner as the bucket, and goes 6 ft. deep in the hardpan when given a pull with the drag cable. The principal parts of the beam and hook were formed from two sheets of 1¼-in. steel plate. Two additional plates cut to the proper shape were inserted between these, at the hook end, making the hook 5 in. thick. Blocks of the same thickness were set into the beam part at necessary places. One-inch countersunk rivets were used in joining the body of the plates, while all the seams were electrically welded, and the snout overlaid with a hard-surfacing steel rod.

Dump Buggies Also Are of All-Welded Construction

The Griffith Construction Co., of Los Angeles, Calif., who have an all-rock contract at Pilot Knob, are hauling all material out of the rock cuts in the latest improved 30-cu.yd. LeTourneau dump buggies. Two of these, supplemented by a 10-cu.yd. Mack truck, are in use. These buggies have 16 pneumatic-tired wheels and an all-welded body of steel plate. In dumping, the body moves backward, scraping the rock off the truck bottom, controlled from the driver's seat on the 75-hp. Diesel Caterpillar tractor, which pulls the buggy. Sideboards are welded to the bodies.

Welders to View Film on Metallic Arc

Robert Holt, of the Chicago Steel & Wire Co., will show motion pictures of the metallic arc in black and white and in its natural colors, before a group of welders, on Aug. 6th, at the Welders' Information Center, 741 West 70th St., Chicago, Ill. At the meeting of this group on July 2nd, a highly instructive talk was given by W. B. Browning, of The Linde Air Products Co., who demonstrated and explained various techniques of welding different metals and alloys; a motion picture was also shown, illustrating the working parts of regulators and torches.

San Francisco Group Hears Talk on Stresses

At the meeting of the San Francisco Section, American Welding Society, held on June 21st, S. H. Edwards, materials engineer for the Standard Oil Co. of California, spoke on "The Effect of Temperature Stresses in Metals From Casting, Welding, Heat-Treatment and Heat-Flow in Furnaces." Following Mr. Edwards' talk, a discussion was entered into dealing generally with the California requirements for testing welding operators.

Hoboken Has School for Welding Operators

A new school for welding operators has been opened in Hoboken, N. J., under the supervision of William Bozman, eastern service manager for the Harnischfeger Corp., of Milwaukee. Although this new school offers a complete course in all types of ferrous and non-ferrous welding, it is also maintained as a clinic for the solving of specific problems encountered by users of welding equipment.

Two Welded Coal Barges Placed in Service

Two 1200-ton welded steel coal barges have just been completed by the Dravo Contracting Co., of Pittsburgh, Pa., at the Christiana River Shipyard, Wilmington, Del., for delivery to the Pennsylvania Railroad Co. The barges will be placed in service in and around New York harbor, and were designed under the personal direction of Warren R. Elsey, superintendent of floating equipment. The individual parts were fabricated at the Neville Island plant in Pittsburgh. These barges are of 50,000-cu.ft. capacity each, and are 130 ft. long, 34 ft. wide and 14 ft. deep.

Milwaukee to Have Industrial Exhibit

The Second Industrial Products Exhibit, held under the auspices of the Milwaukee Association of Purchasing Agents, will take place in the Hotel Schroeder, Milwaukee, Wis., on Oct. 22nd and 23rd, two entire floors of this hotel being given over to this purpose. It is reported that all the 150 exhibit spaces were contracted for by manufacturers by June 1st. Last year's exhibit was visited by approximately 8000 people. A number of welding companies will have displays.

A Welding Engineer's Wife Speaks Her Mind

■ By ONE OF 'EM

Bread

In theory, this city of a million people is without bread. We are in the third week of a bakers' strike that would have caused great inconvenience but for the resourcefulness of the women. Wives who never baked a loaf of bread before in their lives have consulted cookbooks and begged recipes from older housewives until now the ancient technique of breadmaking is a restored art. Very creditable loaves the girls are turning out, too, with that old-fashioned flavor that takes one straight back to childhood and those jam-smeared slices mother dealt out on baking day.

This baking emergency has brought out some new talent and turned some, long recognized, into commercial channels. Housewives, famous for their bread in the old days before baking became a mechanized process, have hunted down the old tin bread-mixer in the attic and are selling bread to the stores. And what a break for the customers! For no baker's bread, however scientifically compounded, ever rivalled the crusty loaves, bulging unevenly over the pan-sides, that wafted their yeasty essence from mother's kitchen.

Now the professors say that odors, more than anything else, have the power to summon memories. For me, the smell of baking bread has that special nostalgic quality. One whiff of that clean, pungent fragrance, and I am again a laughing child, in the security of my mother's sunny kitchen, with starched white curtains billowing in the June breeze against a row of red geraniums on the sill. There is a speckled cat napping in a blotch of sunshine under the windows, and beside him my little sister sits, demurely rocking her doll to sleep. Now we are grown, and life has separated us widely, but the scent of bread-baking in my neighbors' kitchens these days, brings back the time when we were together.

* * *

About Welding People You Know

W. B. Boom, president, Boom Boiler & Welding Co, Cleveland, is a gifted amateur magician.

*

Oliver P. Hanchette, welding engineer, Jos. T. Ryerson & Sons, Inc., Chicago, is a connoisseur of liquors. He makes excellent wines, himself, his cherry brandy being something to taunt your bartender about.

*

C. A. Richardson, manager, welding manipulator sales, United Engineering & Foundry Co., Pittsburgh, is an architect and landscape expert. His fancy runs, not to designing new houses, but to the redesign of old ones, with plantings to match. He has a country place where he tries out his ideas ad lib, since he is a bachelor and has no one to tell him where to plant the sweet peas and when to mow the lawn.

*

Raymond P. Tarbell, welder sales manager, The Ideal Electric & Mfg. Co., Mansfield, O., is one of those studious fellows. Never knows when he knows enough, always eager to learn more. A good-looker, too.

*

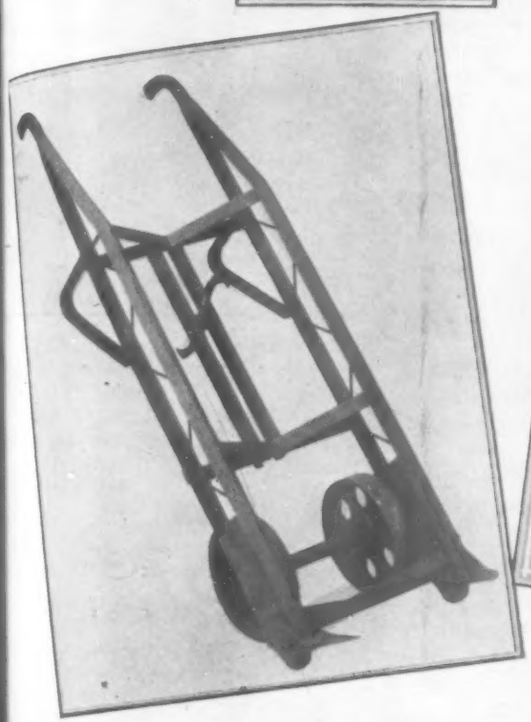
A. F. Davis, vice-president, The Lincoln Electric Co., Cleveland, is a stamp enthusiast as well as an amateur gardener. His beautiful suburban house, banked with unusual evergreens and set among flowering gardens, is a strong interest. The house is impressive with its formal colonial architecture, ivy-grown walls, and its sheltering grove of small shade trees bordered with rhododendrons. A friendly crabapple tree shades a library window, a few feet from a young elm that sprang up uninvited in a niche of wall beside the front door. The crabapple had been planted, the owners never dreaming that it would soon grow to forest-size against the casement. So charming is the effect of these two trees that the Davises have let the upstarts remain, to give to their dignified house a mischievous look.

Mr. Davis likes to get into working clothes when he comes home from business, to putter around in his flower-beds, or rake his driveway to finicking neatness. Mrs. Davis and Mary Jane, 7, stand by to encourage. A battered felt hat and a pipe, of which the less said the better, combined with a suit of clothes which the Salvation Army would spurn, comprise this welding executive's fatigue uniform.

WELDING NEWS
▪ IN PICTURES ▪

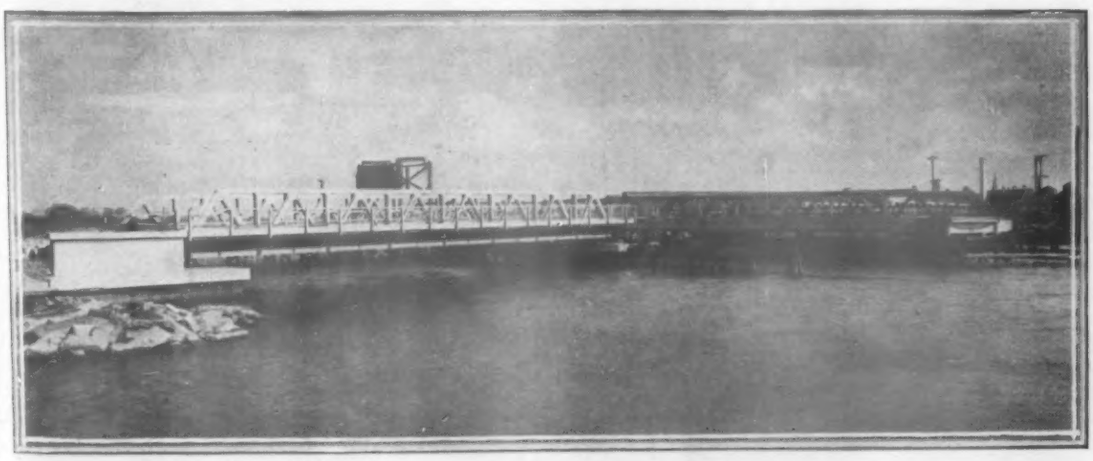
• New side-pour oil delivery can, with cover open, showing empty position. Welded in plant of Farrell Mfg. Co., Joliet, Ill.

• 78 barracudas—count them—says Robert Notvest, of the J. D. Adams Co., the gent standing up, donned in a slicker. Bob caught them off the coast of Catalina Island.



• "Only by welding could we manufacture a sturdy light-weight oil-barrel truck," says G. K. Deeter, of the Lincoln Steel Works, Lincoln, Nebr., and this is the pleasing result.

• Welding is extensively used in this high-voltage Metal-Clad Switchgear, being built in the plant of the Delta-Star Electric Co., Chicago, for the Boulder Dam power house. Such working parts as oil circuit-breakers, mechanisms, linkages, wiring ducts, etc., also employ welding.



• The Riverside-Delanco bridge in New Jersey, showing the two approach fixed spans and the center swing span. The total length of 397 ft. makes this bridge one of the two largest all-welded truss bridges in the world.
(Photograph courtesy of The Lincoln Electric Co.)

What's New in

Equipment and Accessories

New Shielded-Arc Electrode for Either Polarity

A new heavy-coated electrode, known as Superweld No. 77, has been announced by the Steel Sales Corp., 129 S. Jefferson St., Chicago, Ill., for use with straight or reversed polarity. The electrode is covered with an extruded coating which burns during the welding operation, forming gases that envelope the molten metal and protect it from atmospheric contamination while the metal is passing through the arc, and also protects the metal after deposition by the formation of a protective slag. The coating contains a stabilizing element, which increases the welding speed.

Though developed particularly for use with straight polarity, the new No. 77 electrode works equally well with reversed polarity, it is claimed. It is particularly well adapted for work in shops and plants where it is not convenient to change the polarity of the equipment while in use. This electrode is recommended for all medium-carbon steels and is said to be equally suited for welding light- and heavy-gauge material. It is an all-position rod and can be used for flat, vertical, and overhead welding.

The welds are of high tensile strength and ductility, with high specific gravity. The physical properties of the weld metal are: Yield point, 50,000 lb. per sq.in. minimum; ultimate strength, 70,000 lb. per sq.in. minimum; and elongation in 2 in., 20% minimum.

This new electrode is available in diameters of 1/8, 5/32, 3/16, 1/4 and 5/16 in., packed in 50-lb. containers.

Extruding Machine Processes Wire Directly From Coils

An extruding machine for processing electrodes, that takes the wire from a coil, straightens, cuts, and extrudes at a speed of 100 ft. per minute, has been announced by C. J. Holslag, of the Electric Arc Cutting & Welding Co., Newark, N. J. This machine is recommended for certain production set-ups. For heavy production, on the other hand, Mr. Holslag recommends a separate straightening and cutting machine, or battery of them, the cut wire being delivered into the hopper of the extruding machine, in view of the fact that the cutting and straightening operations can be performed faster than the extruding process. In the case of certain rods, however, all operations can be timed together with advantage.

Improved Gas Economizer Announced by Rego

An improved design of the Rego Economizer, No. 3360, and a reduction in prices for this unit and its parts, have been announced by The Bastian-Blessing Co., 240 E. Ontario St., Chicago, Ill. The lever-arm assembly has been redesigned so it automatically keeps the plunger mechanism in adjustment. In place of the adjusting screws formerly used, a rocker is attached to the top of the lever, which automatically adjusts itself. The bracket for attaching the economizer to the bench or table has also been improved. The new bracket, as well as the new lever-arm assembly, has been designed to fit the old-style economizer and can be substituted for the old parts.

Low-Resistance Electrode Holder and Clamps

A new electrode holder that provides positive rod contact, yet contains no springs, levers or soldered joints, has been announced by Metalweld, Inc., 26th and Hunting Park Ave., Philadelphia, Pa. The electrode is held in a vise-like grip, yet a slight twist with a fresh rod releases the old stub and another twist in the opposite direction places the new electrode in the jaws of the "vise," and the welder is ready to strike the arc. The grip is screw-actuated and is not affected by heat. The elimination of poor contact keeps the handle from heating. A long fiber handle is provided. The operator can grasp the holder close to the electrode without discomfort. The design is very simple; there are no joints to work loose and no parts to get out of order and be replaced. More than 300 of these holders are now in use by the Philadelphia Navy Yard, the manufacturer states.

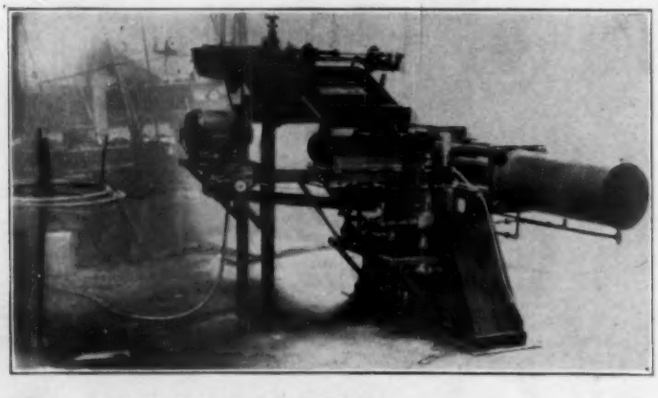
A Twist, and the Stub Falls Out—Another Twist Clamps the Electrode.

Used with Sure-Grip Clamps, another recent development of Metalweld, Inc., these holders establish a perfect path of low resistance from the generator to the arc. Poor contacts, which often result in porous welds, are eliminated and the welder is given full opportunity to produce good welds.

New General-Duty Welding Torch

The new Purox No. 35 General Duty Welding Torch has just been announced by The Linde Air Products Co., 30 East 42nd St., New York, N. Y. Constructed of extruded brass, monel metal, and drawn copper, with silver-soldered tubes, it is built to withstand rough treatment. Its wide range of usefulness makes it equally adaptable to the lightest as well as the heaviest work to be found in any welding shop. It is listed by Underwriters' Laboratories, Inc.

The ribbed design of the extruded brass handle reinforces the torch and enables it to be easily gripped. The connections are of the ferrule type and extend parallel to the axis of the handle. The individual mixers in each welding head are so designed that maximum resistance to flashback is afforded, and at the same time the effective range of each size of tip is greatly increased. Nine



Machine for Straightening, Cutting, and Processing Electrodes.

tips perform the duty of 15, the number usually required. The monel-metal seating surfaces are protected, wear-resistant, and easily removable for cleaning or replacement.

A hexagonal socket arrangement permits the welding head to be assembled in the most convenient of six optional positions in relation to the body. This arrangement also prevents injury or scoring of the seating surfaces.

The tips, of hard-drawn copper, are said to withstand excessive heat and to maintain perfect balance in the torch as a whole.

The standard Purox No. 21 Cutting Attachment can be used to transform the new torch into a light-duty cutting torch.

Automatic Electric Resistance Machine for Heating Studs

For the heating of tapered studs made from screw-machine stock for subsequent forming in a press, the automatic electric resistance heating machine, shown in the illustration, has been developed by The Taylor-Winfield Corp., Warren, Ohio. The machine meets a demand for 1000 heated studs per hour, and the actual current dwell for the heating of two pieces simultaneously is less than three seconds. A 75-kva. transformer is used, mounted within the base. In principle and construction, the machine follows the general arrangement of the company's spot

Can Heat 1000 Studs per Hour.

or projection welders. Except for the feeding of the studs by hand into the indexing fixture, the operation of the machine is entirely automatic. The same general scheme represented by this machine is applicable to a wide variety of heating operations, it is claimed.

Adams Welders Now Have All-Steel Housings

An all-welded steel housing is a feature recently adopted for the line of arc welders manufactured by the J. D. Adams Co., Indianapolis, Ind. These welders are of the vertical type and were described in the September, 1934, issue of *The Welding Engineer*. The new housing is made of 9/16-in. plate and replaces a combination steel and cast-iron housing. The new design insures the machine against damage from abuse in handling or from heavy articles being dropped on it. The housing also provides a highly rigid support for the upper thrust bearing, which carries the weight of the rotor. The increased space around the commutator and brush holders afforded by this design permits a high degree of accessibility and convenience in changing brushes or in servicing the commutator.

The current indicator has also been changed, so that the hand travels the full range of the scale for the welding range of each machine, thereby affording much clearer graduations for reading settings.

New Flux Eliminates Cleaning of Parts

"Braz-Weld," a new brazing and welding flux for cast iron, malleable iron, steel, stainless steel, copper, brass, bronze, and various other metals, has been announced by the Braz-Weld Co., 2844 California Ave., St. Louis, Mo. This flux is supplied in paste form and is applied with a brush. Cleaning or grinding of the parts to be welded or brazed is eliminated, as it is claimed that this flux cuts through any coating such as rust, grease, paint, enamel, etc. "Braz-Weld" flux melts at 1200°F. It is not poisonous, so the manufacturer claims, and its fumes do not injure or irritate the workman. It does not form glass on the joint, so cleaning costs are saved.

New SX Torch Is Smaller Brother to GX Unit

With certain features of the GX Universal torch retained, the new SX torch, announced by The Bastian-Blessing Co., 240 E. Ontario St., Chicago, Ill., has been developed as a light-weight unit ideally adapted to a wide variety of manufacturing operations such as automobile-body work, light-sheet-metal welding, light brazing and silver soldering, aircraft welding, manufacturing of metal doors, windows and metal furniture, tank welding, aluminum welding, etc. Its light-weight makes it especially desirable for continuous operations where fatigue of the operator controls the production output. The tips and goosenecks are of small size to permit working in close quarters.

This torch has a length of 14½ in., and weighs, with one tip, 13½ oz. The gooseneck and tips can be used with the standard GX handle. Moreover, the GX tips and GXK cutting attachment can be used on the SX handle, converting the SX torch into a cutting torch.

The SX torch is provided with five tips, covering all ranges of welding from 24 gauge to 5/16-in. steel plate, and the mixer has sufficient capacity to handle the entire range. The mixer nut sleeve and gooseneck are made of a special aluminum alloy having strength equal to ordinary steel. The black anodized finish of these parts matches the finish on the handle, and is highly resistant to corrosion and abrasion.

For heavy work, GX tip assemblies can be used, connected to the SX handle. The GKA 6-in. extension may also be used to lengthen the SX assembly.

The operating pressures of the SX torch, using standard tips, can be varied over a wide range without causing flashback, it is claimed.

Line of Medium-Pressure Acetylene Generators

Acetylene generators of the medium-pressure type, for stationary service, designated as Oxweld Type MP-5, have been announced by The Linde Air Products Co., 30 East 42nd St., New York,

300-lb. Oxweld Generator.

N. Y. These have a carbide capacity of 150, 300, and 500 lb., respectively, with acetylene-generating capacities ranging from 300 to 1,000 cu. ft. per hr. The illustration shows the 300-lb. generator. Except for slight differences in design, all three generators resemble each other in essential details, and they all are listed by Underwriters' Laboratories, Inc.

Each generator has all controls protected by a housing, which can be padlocked, if desired. The gravity-type feed-control unit is self-contained and is bolted to the inside of the upper section of the generator. Withdrawal of acetylene gas operates a diaphragm-type feed control, which causes a feed valve to open. The diaphragm is sensitive to slight changes in pressure, and the carbide is released evenly in just the amount needed to maintain a constant pressure.

Rapid emptying and recharging are made possible by a large lubricated plug valve for draining the carbide residue, a water-filling valve of similar construction, and an unusually large carbide-charging door. All operating parts are readily accessible for inspection and adjustment.

New High-Strength Alloy Has High Heat Conductivity

A new copper alloy, known as Mallory 3 Metal, has high electrical and heat conductivity and a strength equal to that of mild steel, making it suitable for spot-welding tips, flash-welding dies and seam-welding wheels, according to P. R. Mallory & Co., Inc., Indianapolis, Ind., who developed the metal. The metal stands up under high heat, and is particularly valuable where water cooling is not provided.

This metal consists predominately of copper, and is the equal of copper in its coefficient of resistivity, coefficient of expansion, modulus of elasticity, and corrosion resistance. Forgings and rods made of the metal have an electrical conductivity of 80% to 85% that of copper, or better, it is claimed.

Other uses suggested for the metal include overhead conductors, such as trolley wires, commutator segments, hot-water heating coils, and as sand castings.

Announces New Portable Acetylene Generator

The "Little Pal" portable acetylene generator, having a carbide capacity of 20 lb., has been announced by the Modern Engineering Co., 3411 Pine Blvd., St. Louis, Mo. This generator is approved by the National Board of Fire Underwriters. The shell and hopper are of all-welded construction, being made of 16- and 18-gauge metal. The shell is factory-tested at 35 lb. pressure. The bottom is of inverted construction, and has a heavy band around it. The generator is equipped with a safety relief valve of the diaphragm type. A combination flash-back check and gas scrubber, equipped with a special water drain back, is said to prevent moisture from being carried over through the hose into the torch. A carbide drop-lock in the hopper stops the carbide feed. The generator has about 1½ cu.ft. of gas-storage space. The unit is 45 in. high, and the largest diameter is 19 in.

20-Lb. Generator With Welded Steel Shell and Hopper.

Trade Literature

"The Metallurgy of Oxyacetylene Welding of Steel" is the title of a booklet published by The Linde Air Products Co., 30 East 42nd St., New York, N. Y. In clear, simple language, this book compares the metallurgy of open-hearth practice to that of steel welding, and discusses expansion and contraction, crystallization, heat-treatment, addition of alloys, and other metallurgical phases of welding. It also describes the carburizing-flame technique for welding steel.

"Alcoa Aluminum and Its Alloys" is the subject of a 91-page booklet published by the Aluminum Co. of America, Pittsburgh, Pa., dealing with the physical properties of these metals, their fabrication by welding, resistance to corrosion, and heat-treatment. An elaborate appendix lists tables of analyses, properties, conversion factors to other metals, conditions for heat-treatment, commercial sizes and tolerances, tempers, etc.

"Thermit Welding—Industry's Master Maintenance Tool" is the title of a new illustrated 16-page booklet just published by the Metal & Thermit Corp., 120 Broadway, New York, N. Y. The booklet describes the thermit process as well as many types of thermit-welded repairs. Particular attention is given to the economy and permanency of thermit repairs, and actual cost data are given in a number of instances.

"Facts About Welded Piping for Buildings" is the title of a booklet issued by the Air Reduction Sales Co., Lincoln Building, New York, N. Y., describing the advantages and economies of Aircowelding of piping. The brazing of pipe is also dealt with. Sample specifications are given, covering pipe welding for heating, plumbing, refrigeration and power-piping installation. The booklet is well illustrated.

A new price list and data book on stainless and heat-resisting alloys has been issued by Maurath, Inc., 7309 Union Ave., Cleveland, Ohio. This book contains a complete description of the electrodes of the company and also gives the analyses of alloys manufactured by various companies.

Electric hoists of both the trolley and hook types, in capacities up to 6000 lb. are listed in a folder issued by the Me Collum Hoist & Manufacturing Co. Downers Grove, Ill. Another folder by the same company lists and describes their line of ball-bearing spur-geared hand chain hoists.

General maintenance applications of metal-spraying equipment are covered in a pamphlet issued by the Metallizing Co. of America, 1218 Long Beach Ave. Los Angeles, Calif. Photographs show equipment coated by metal spraying that have been in service a number of years.

Brass, copper, bronze, aluminum and aluminum alloys, including sheets, rounds, structural shapes, tubing, pipe and pipe fittings, are listed and design data given in a 32-page catalog issued by Williams & Co., Inc., 901 Pennsylvania Ave. N.S., Pittsburgh, Pa.

The elimination of "weld decay" in austenitic stainless steels is discussed in a folder issued by the Electro Metallurgical Co., 30 East 42nd St., New York, N. Y., entitled "Stainless Steel Treated With Columbium".

A folder on the USL "Protected Arc" welder has been issued by the USL Battery Corp., Niagara Falls, N. Y. Performance is shown by means of oscillograms and charts, and specifications are given.

The new "Fasco" spot-welding gun with cable is described and illustrated in a folder recently issued by the Fassler Welding Machine Co., 424 Stormfeltz-Loveley Building, Detroit, Mich.

"Electromet Review" is the title of a new house organ issued monthly by the Electro Metallurgical Co., 30 East 42nd St., New York, N. Y., pertaining to interesting uses of alloys.

The economy and safety in using ECGCO cover glasses is stressed in a folder issued by the Electro Cover Glass Co., 803 Westinghouse Building, Pittsburgh, Pa.

Mr. C. G. Blackwell, Tobin Bronze enthusiast, and his Dayton Welding Co. shop.

GARFIELD 2084 — C. G. BLACKWELL, Prop.

Dayton Welding Company

GAS AND ELECTRIC WELDING

13 S. ST. CLAIR STREET

DAYTON, OHIO

June 6 1935

The American Brass Company
Waterbury, Connecticut

Gentlemen:

"To say I'm sold on Tobin Bronze is putting it mildly. For more than 20 years, I have used this welding rod...and today all of us prefer it to any other. Why? Because Tobin Bronze is more economical to use and helps my men make better, more dependable welds.

C. G. Blackwell

Welding a Lion's Tail with Tobin Bronze

During the Dayton flood in 1913, this monument was washed from its base and the lion's tail was broken off. With Tobin Bronze Mr. Blackwell welded the broken part, which weighed 75 pounds, to the main statue. Today . . . 22 years later . . . the weld is still sound. Tobin Bronze makes tough bonds!

Why this Ohio Welder uses Tobin Bronze *exclusively*

THROUGHOUT his long experience in the welding business, Mr. C. G. Blackwell has done many unusual jobs with Tobin Bronze. Invariably the work has been satisfactory—a very good reason why Mr. Blackwell will use no other rod.

Thousands of experienced welders will accept no substitute for Tobin Bronze when it comes to the general oxy-acetylene welding of cast and malleable iron . . . locomotive cylinders, automobile engine blocks, cast iron pipes, machinery parts and similar equipment.

Time-tried Tobin Bronze carries the name stamped every 12 inches in each rod. So, when you ask for "Tobin", look for this mark and make sure you are getting the genuine product.

ANACONDA

MELTING POINTS OF ANACONDA WELDING RODS

Material	Approximate Melting Point Degrees	
	Cent.	Fahr.
Tobin Bronze*	885	1625
Manganese Bronze	870	1598
Brazing Metal	930	1706
Economy Bronze*	885	1625
Everdur*	1019	1866
Anaconda 520	885	1625
Phosphor Bronze A	1050	1922
Phosphor Bronze E	1070	1958
Phosphor Bronze D	1000	1830
Phosphor Bronze C	1025	1877
Silicon Copper	1083	1981
Deoxidized Copper	1083	1981
Electrolytic Copper	1083	1981
Nickel Silver	1055	1931
Ambrac*	1150	2102

*Trade-marks Reg. U. S. Pat. Off.

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ANACONDA WELDING RODS

Commercial News

Harris Calorific Co. Starts Construction of Factory

The Harris Calorific Co. will build a plant on a site 250x132 ft., with an offset 50x132 ft., on the west side of Cleveland, which land has already been purchased by the company for this purpose. This action followed the government's taking over their present site for a low-price housing project, as announced in the May issue of *The Welding Engineer*. The new factory will have a picturesque setting, being located on high ground, directly overlooking Edgewater Park and the Cleveland harbor. Ground has been broken and construction started on the building, which will be 240x125 ft. That part of the building housing the executive and general offices will be two stories, and the remainder will be of one-story construction.

G. B. Purcell, Inc., division of Thomas Welding Laboratories, Inc., 15120 Woodward Ave., Detroit, Mich., have been appointed authorized distributors for "Rego" oxyacetylene welding and cutting equipment and for "RegOroDs". Thomas J. Norden, in charge of the district "Rego" office for the past five years, becomes general manager of sales of welding equipment and supplies for the new distributor, according to an announcement by Harris A. Goodwin, district manager for Bastian-Blessing, who states that under this arrangement G. B. Purcell, Inc., takes over all activities of the former district office and will maintain stocks and repair service.

The Ideal Electric & Manufacturing Co., Mansfield, Ohio, announce the appointment of the following concerns as distributors for the "Noel" line of arc-welding machines: Carr-Weller Engineering Co., 633 Larned St. West, Detroit, Mich.; D. S. Mair Machine Corp., 505 Esperson Building, Houston, Tex. (also covers the Dallas territory); and F. E. Smith, Ltd., 343 Dominion Square Building, Montreal, Canada, who is the Canadian distributor.

C. O. Conzett, formerly demonstrator and service engineer for the Los Angeles branch office of The Lincoln Electric Co., has been appointed sales representative for that company in the southern district of the Los Angeles territory. Mr. Conzett will also cover the Metropolitan aqueduct project now being constructed from the Colorado River.

The Welding Equipment & Machinery Corp., 240 S. Boyle Ave., St. Louis, Mo., has been consolidated with the Machinery & Welder Corp. and will be operated under the latter name, in its present location, as a branch office. Complete stocks of materials, including General Electric welding equipment and electrodes, will be carried.

The Welders Supply Co., of Tulsa, Okla., and Dallas, Tex., has been acquired by Compressed Industrial Gases, Inc., Chicago, Ill. Messrs. Harter and McCullough are still interested in the success of the Welders Supply Co., it is announced, although Mr. Harter will not be actively in charge of its management.

The Calumet Steel Co., Chicago Heights, Ill., has been acquired by the Borg-Warner Corp. and is being operated as a Borg-Warner subsidiary. Roy C. Ingersoll is the new president of the Calumet company, F. G. Carrel is vice-president, and Mathew Keck is secretary and treasurer.

C. D. Williams, formerly associated with the Stoody Co., of Whittier, Calif., recently joined the sales force of The Lincoln Electric Co., and will represent that concern in the northern district of the Los Angeles territory.

All divisions of The Babcock & Wilcox Co. that were formerly located at 130 Cedar St., New York City, have been moved to 19 Rector St. The general office of the company remains at 85 Liberty St.

J. F. Lincoln, president of The Lincoln Electric Co., Cleveland, Ohio, sailed on June 26th for a 60-day business trip to England and South Africa.

The Moon Welding & Supply Co., Kokomo, Ind., now are distributors for USL arc welders and Harris gas-welding and cutting equipment.

The Torchweld Equipment Co., Chicago, Ill., paid a semi-annual dividend of 5% as of July 1st.

Notes From the Field

Wm. R. Garten, head of the Sutton-Garten Co., 401 W. Vermont St., Indianapolis, Ind., tells of the part his company played in coupling an adjoining building to the Wm. H. Block Co., one of the largest department stores in Indianapolis. "Not a single rivet was used," says Mr. Garten. "We employed six men in three shifts, 24 hours a day, for a total of 900 hours." Two 300-ampere arc welders were used. Steel plates 2½ in. thick and 14 in. wide were drawn up to the old columns with clamps and welded in place. Business continued without interruption while the work was being done.

The qualifying of electric-arc welders who will work on the new all-welded bridge to be built over Clear Creek at Franklin, Ohio, was held at the plant of the Ohio Welding & Boiler Works, Cincinnati, Ohio, on July 5th, with R. E. Miller, project engineer for the state of Ohio, and Walter Schweitzer, president of the welding firm, supervising the tests. The shielded-arc process will be used throughout. The structure will be 140 ft. long and 40 ft. wide, and will weigh 311,000 lb. The welds will be tested by the stethoscope method.

A large order for condenser equipment for the U. S. Navy, including turbines, blowers and water chests, is being manufactured by the Youngstown Welding & Engineering Co., 3700 Oakland Ave., Youngstown, Ohio. This company, of which C. G. Watson is manager, manufactures welded steel truck-tanks and steel valves, also steel doors for open-hearth furnaces. Other products of the company, which is one of the largest in Youngstown, and is now employing about 60 men, include pickling crates made of monel metal and nickel dry-cleaning machinery.

The Dravo Contracting Co., of Pittsburgh, Pa., has just completed the construction of a large tank carrier in their Neville Island shipyard for the barging of gasoline from the lower Mississippi river to the Pittsburgh harbor. This barge, of all-lap-welded type, was built for the Union Barge Line of Pittsburgh. It is 175 ft. long, 26 ft. wide and 11 ft. deep, with a capacity of 250,000 gallons. The barge is now in tow of the motorship *Neville* on its way to New Orleans to be loaded with gasoline for delivery to the plant of the Republic Oil Co. at Coraopolis, Pa.

An 11-ton fabricated stainless-steel job, requiring two months to complete, was recently finished by the Alloy Metals Welding Co., 1339 Trumbull

Welding Rods for Moly-Nickel Castings

Have you noticed that gray iron castings are being improved and their strength increased by the addition of Nickel and Molybdenum (Moly)? Moly added to gray iron closes the grain which prevents leakage under high pressure and temperatures; it also adds wear resistance and strength and increases the toughness. The addition of Nickel to this close grained casting increases its machinability.

It is also claimed that the addition of Moly to cast iron gives the resultant product a better finish.

Modernize your shop and welding methods by ordering from your dealer a stock of Moly-Nickel cast iron welding rod for Moly-Nickel castings and other gray iron castings that are subjected to high pressures, extreme heats, high loads or great wear.

Moly-Nickel Analysis	*Some Moly-Nickel Applications*
Carbon— 3.30 to 3.50	Gears
Manganese— .50 to .70	Flywheels
Sulphur-Max .10	Valves
Phosphor .15 to .30	Pulleys
Nickel 2.00 to 2.25	Dies
Molybdenum .40 to .60	Cylinder Liners
	Cylinder Blocks
	Cylinder Heads
	Clutches
	Brake Drums
	Pistons
	Bottle Molds
	Ingot Molds
	Hot Water Heaters
	Exhaust Manifolds
	Frames for Machine Tools

For ordinary cast iron welding, to obtain high strength and machinability demand Fuse-Well, the most popular cast iron welding rod manufactured. Available in six sizes either □ or O.

Write for Name of Nearest Distributor and gratis sample of Moly-Nickel Welding Rod.

Fuse-Well Cast Welding Rods

Chicago Hardware Foundry Co.
635 Engineering Bldg.
North Chicago Illinois
Largest Manufacturer of Cast Iron Welding Rods

Just like the parent!..

• Page Hi-Tensile Electrodes produce a weld metal with practically all of the physical properties of the parent metal.

• Page Hi-Tensile Electrodes are heavily coated and accomplish this objective—which is not always the case when bare or lightly coated electrodes are use.

• The heavy coating employed by Page provides a "shielded arc." Approximately equal ductility is obtained, resistance to corrosion and impact is increased, surface oxidation is prevented and the cooling rate is lengthened. Spatter loss is less and shrinkage stresses are reduced.

• Page Hi-Tensile Electrodes will assure you better welding. And the Page Engineering Staff are eager and willing to counsel with you, particularly if your welding problems are difficult.

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PAGE HI-TENSILE "Shielded Arc" WELDING ELECTRODES
COATING STEEL
STEEL AND WIRE PAGE QUALITY PRODUCTS

Ave., Detroit, Mich. This company also recently welded a 16-gauge aluminum cornice for a government building. In the four months that this shop has been established, it has built up a reputation in the welding of aluminum, stainless steel, nickel, monel metal, and other metals and alloys. The firm is headed by Andrew Irons and Frank Williams.

Consolidation of its welding plant at 3400 Beekman St., with its plant at 1110 Richmond St., has been effected by the Davis Welding & Manufacturing Co., Cincinnati, Ohio. The company disposed of its Beekman St. plant, a steel-and-brick one- and two-story structure, with two acres of land, to the Fox Co., metal-specialty manufacturers. The Davis company is retaining approximately five acres of land adjoining the Beekman St. plant to be utilized for expansion of its welding business, should the occasion arise.

The Pomona Valley Machine Works are enlarging their plant by an addition to the main building and the erection of a separate welding shop. The structural work of the new addition is of all-welded steel. The old building across the alley, formerly used in connection with the main shop, is being vacated, and all work will be concentrated under one roof in the newly enlarged main plant. The concern specializes in packing-plant equipment, pumps and general machine work.

The building of a large welded steam boiler is one of the present projects under construction at the Erb Machinery Co., 727 W. Madison Ave., Youngstown, Ohio. This shop specializes in the repair of mill machinery and the manufacture of replacement parts for these machines, and seven men are employed on this large type of work. Mr. Erb reports an increased business extending from the beginning of this year.

Delivery of 10,000 tons of welded water line for the city of St. Louis, Mo., is being completed by the McClintic-Marshall Corp., of Pittsburgh, Pa. This huge contract was executed at the Leetsdale, Pa., works and involves various units of 60-in., 54-in. and 48-in. carbon-arc-welded pipe. The pipe is to be used for a new water supply system on the outskirts of St. Louis, replacing old pipe and giving added capacity.

At the Trademen's Fair, to be held in Weatherford, Okla., Aug. 14th and 15th, the program will be in charge of various manufacturing and supply companies, including those in the business of furnishing welding equipment and supplies. The Fair is being promoted by the city of Weatherford and by the local group of the Western Oklahoma M-W-B Association, consisting of machinists, welders and blacksmiths.

Numerous changes in a large industrial plant requiring considerable welding are mainly responsible for his business being good, according to Al Martin, head of the South Side Welding Co., Indianapolis, Ind. "We have been very fortunate in landing the job, and as this plant makes frequent changes requiring much welding, I believe we will have plenty work for some time to come," he says.

The Association of Master Welders, of Indianapolis, Ind., will hold a meeting some time within the next two or three weeks in an effort to stimulate new interest in association affairs, according to Wm. R. Garten, of the Sutton-Garten Co., who is president of the Indianapolis association. The membership of the association includes most of the larger welding companies of Indianapolis.

For his contributions to science and engineering, including, among other things, the development of atomic-hydrogen welding, Dr. Irving Langmuir has been awarded the Holley Medal for 1934, the presentation having been made on June 20th by the American Society of Mechanical Engineers. Dr. Langmuir is associate director of the General Electric Research Laboratory.

The Treadwell Construction Co., Midland, Pa., has been awarded a contract by the United States Engineers office in Pittsburgh for a ¾-in. plate conduit welded lining for use in connection with the construction of the Tygart River Reservoir Dam near Grafton, W. Va. The contract involves 1075 tons and amounts to 78,000. The work is to be completed early in 1936.

F. G. Joyce, owner of the Royal Welding Shop at 5809 W. Vernor Highway, Detroit, Mich., has had some worries, recently sustaining the loss of two sets of gauges, two welding torches, and one cutting torch, stolen at night from his shop. This represents a loss estimated at $170. "And I didn't have a cent of insurance on it," adds Mr. Joyce, dolefully.

The J. J. Finnigan Co., Inc., has the distinction of being the first welding shop in Atlanta, Ga., and the second in the state, to qualify for U69 (formerly known as Class 2) welding under the A. S. M. E. Unfired Pressure Vessel Code, says W. J. McAlpin, president. In the qualification tests held recently, five out of five welders qualified on the first test.

The A. N. Richey Co., of 134 E. Col[fax], South Bend, Ind., specializes in radiator work. Hot summer weather causing radiators to overheat and boil brings the company as much work as the freezing temperature of winter. However, this summer's coolness, though pleasant for general comfort, has lessened the repair work, to some extent.

A permanent exhibit of alloys, ferrous and non-ferrous metals, and plastics in the form of raw materials, semi-finished parts, and finished parts, will be opened on Sept. 1st at Rockefeller Center, New York City, by Metal Products Exhibits, Inc. The exhibition will occupy the third floor of the International Building, and space is laid out for 500 exhibits.

Several papers on welding are included in the program of the 31st annual convention of the Association of Iron and Steel Electrical Engineers, to be held at the William Penn Hotel in Pittsburgh, Pa., Sept. 24th to 26th. An iron and steel exposition will be held concurrently with the convention.

Over 300 steel plow shares, 75 pairs of corn-planter runners and 1,200 corn-cultivator shovels were rebuilt this spring by Huffman Bros. and Gavin, of Bluffton, Ind. "We have found this to be one of the best side-lines ever put into use in our welding shop," stated Fred G. Huffman, of this firm.

Weisbrod & Ernst, contractors, of Los Angeles, Calif., have been awarded the contract for welding eight miles of 48-in. steel water main for the city of San Diego. This pipeline is to complete what is known as the city's El Capitan project. The work will get under way about July 20th.

Albert Reichmann, of the Chicago office of the American Bridge Co., has been elected a vice-president of the company. Mr. Reichmann is vice-chairman of the Chicago section of the American Welding Society.

Welding equipment and supplies were exhibited and demonstrated at the 8th annual convention of the Iowa State Horseshoers' and Blacksmiths' Association, held in the Wahkonsa Hotel, Fort Dodge, Iowa, on June 21st and 22nd.

Reed Rasmussen, of Los Angeles, Calif., has acquired the equipment of the North Electric Welding Shop, located at 1157 West 38th St., and is moving into new quarters at 1015 W. Washington Blvd.

Struck by a large casting being conveyed by a traveling crane at the plant of the American Steel Pipe & Tank Co.

Alhambra, Calif., Frank Judy, a welder, recently suffered a fractured leg and lacerated ankle.

The National Machine Tool Builders Association, 1220 Guarantee Title Building, Cleveland, Ohio, will hold their annual machine-tool show in the Cleveland Auditorium, Cleveland, Ohio, on Sept. 11th to 21st.

The Gulf Refining Co., of Pittsburgh, Pa., has awarded a contract to the Stacey Bros. Gas Construction Co. of Cincinnati, Ohio, for a 5000-cu. ft. welded gas-holder, to be erected at the Gulf Refining Co.'s plant at West Port Arthur, Texas.

The American Oil Co., Pittsburgh, Pa., is expected to let a contract for eight all-welded steel tank barges July 15th. These barges are to be used for the transportation of petroleum products.

The Purvis & Foster Welding Co., 1929 E. Larned St., Detroit, Mich., have been kept busy welding and repairing boilers and putting lake excursion boats into shape.

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Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines. Count 8 words to line. Add 6 words for keyed address.

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New Low-Temperature Gas-Welding Process — Exclusive rights covering limited territories, available to responsible welding shops. Fully developed and widely used abroad. Castings repaired at brazing temperature positively without cracking or distortion or visible signs of repairing. For details address Jul-1, The Welding Engineer.

FOR SALE

Guaranteed Welders—Two 300-ampere Type FKW Lincoln gasoline-driven arc welders. Priced low. Completely guaranteed. Other types in stock. Dealer's correspondence invited. Service Co., 3732 Cedar Ave., Cleveland, Ohio.

Fly Ball Governors—Adapted to all makes of auto engines; belt driven, flat or V. Price, $6.50 prepaid. Satisfaction guaranteed. In ordering state style of belt. Wm. D. Alber, Beatrice, Nebr.

Bargains—Lincoln Welder, 300-ampere, Buda engine driven, $500. Westinghouse Welder, 250-ampere, electric-motor driven, $250. Welding Engineering Co., Milwaukee, Wis.

Bargains—Demonstrator Arc Welders. Gasoline and electric drive. 30 days' trial. Easy terms if desired. Write Ken's Exchange, Box U-751, Troy, Ohio.

Gas-Burning Preheaters—Will do your work from smallest to largest job. Much cheaper than charcoal. For sale by C. M. Hale, Wilmington, Ohio.

REWARD

$50.00 REWARD

For confidential information of whereabouts of the following Dualarc welding machines with serial numbers: P20-251-2512-H9-6282-169049, and Machine 5932-BB-6C-176859. Further description: Standard Duararc gas sets with A.C. auxiliary power for lights, drills, grinders, complete with Continental Red Seal power unit. When last seen these sets were mounted on trucks, one in Connecticut and the other in Norfolk, Va. Write Electric Arc Cutting & Welding Co., Newark, N. J.

HELP WANTED

Combination Sales and Service Man Wanted—To contact jobbing and user trade for manufacturer of outstanding AC welder with real patented features. A few choice territories open on strictly commission basis. State experience, territory desired, references, etc. Will-Weld Manufacturing Co., 1501 Jackson St., Omaha, Nebr.

POSITIONS WANTED

Combination Welder—20 years' experience in general repair work, heavy and light, also boiler and blacksmith repairs, plows, tractors, marine works, etc. 40 years old; married. Al Brumbelow, 4006 N. Poinsettia St., West Palm Beach, Fla.

Young Man—With 2½ years' engineering training and a thorough knowledge of welding. Desires responsible position with a chance for advancement. Free to move. Robert G. Hill, 3207 Gilbert Ave., Cincinnati, Ohio.

EVER-KLEAR COVER LENS

Not only more economical than plain cover glass, but are an eye saver also. Molten metal sparks will not fuse to the surface. Guaranteed 200 welding hours. Satisfaction guaranteed or money refunded.

Size 2x4¼" for arc-welding shields—$2.40 per dozen.
Size 45 to 50 M.M., inclusive, for welding goggles—35 cents per pair.

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Any welder can use it. Put up in square cans, one pound to the can, at $2.00 per pound. Send for a can today.

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THE NEW JUNIOR ARC WELDER
MODEL D meets the need for a

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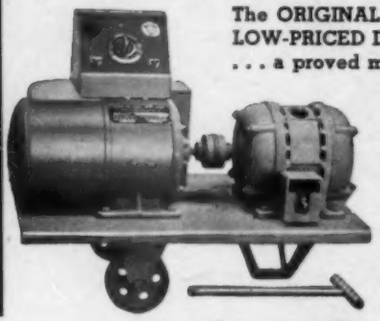
D. C. Arc Welder



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low priced and very efficient

Welding range from 25 to 120 amperes. 40 volts open circuit; welding voltage at the arc 17 to 25 volts, using metalic electrode 1/16, 3/32 and not over 1/8 inch. Also Model F gas-engine driven, same capacity.

It will pay you to find out about this welder. Write to

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